

HOW TO REPAIR CD PLAYERS

MARCH 1998

# Electronics NOW®

NEW SECTION!  
**Prototype**  
A Look At Tomorrow's  
Technology

## Build a High-Performance **Logic Analyzer**

Capture up to 40-million  
samples a second

## Maintaining Your Own Personal Computer

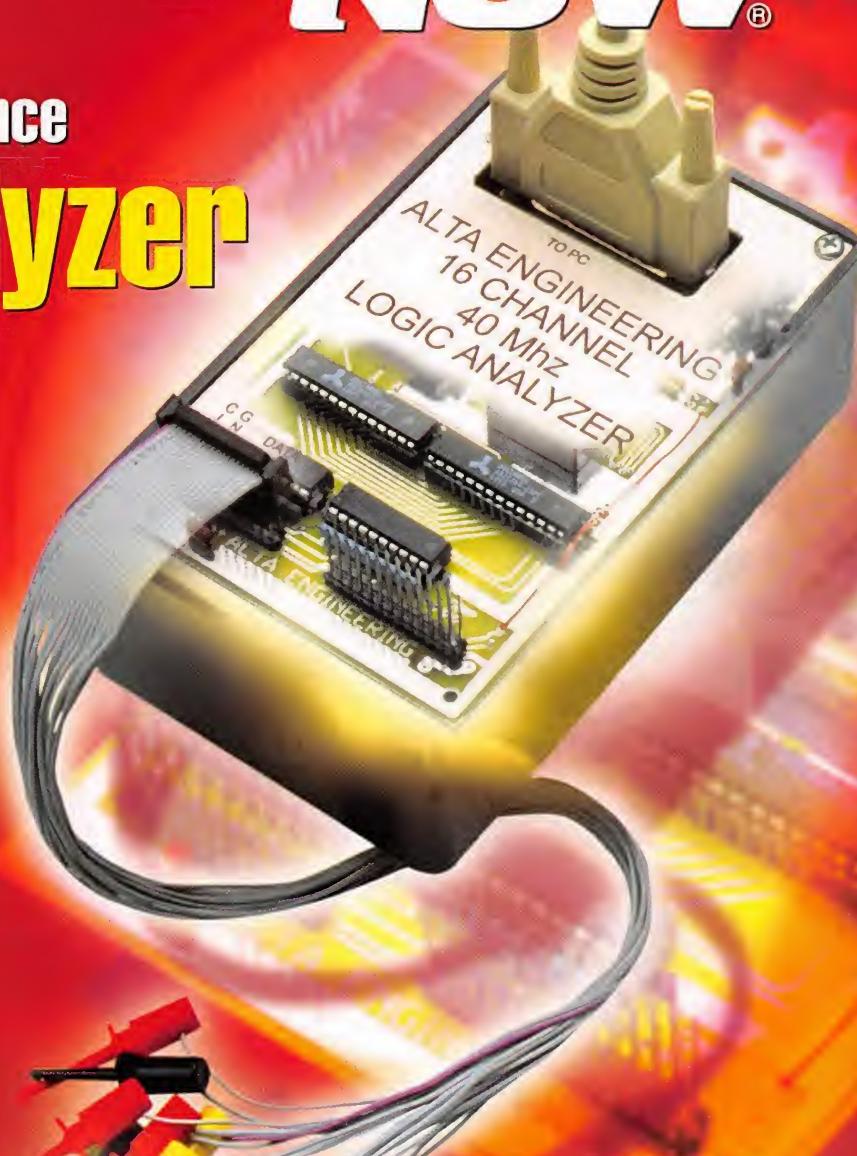
These simple steps can keep  
your computer—and your  
data—in the best of health

## Build a "Home-Brew" **Temperature Controller**

A "must-have" accessory if you  
make your own beer or wine

## Restoring a **Reel Recorder**

Bring that golden oldie  
back to life

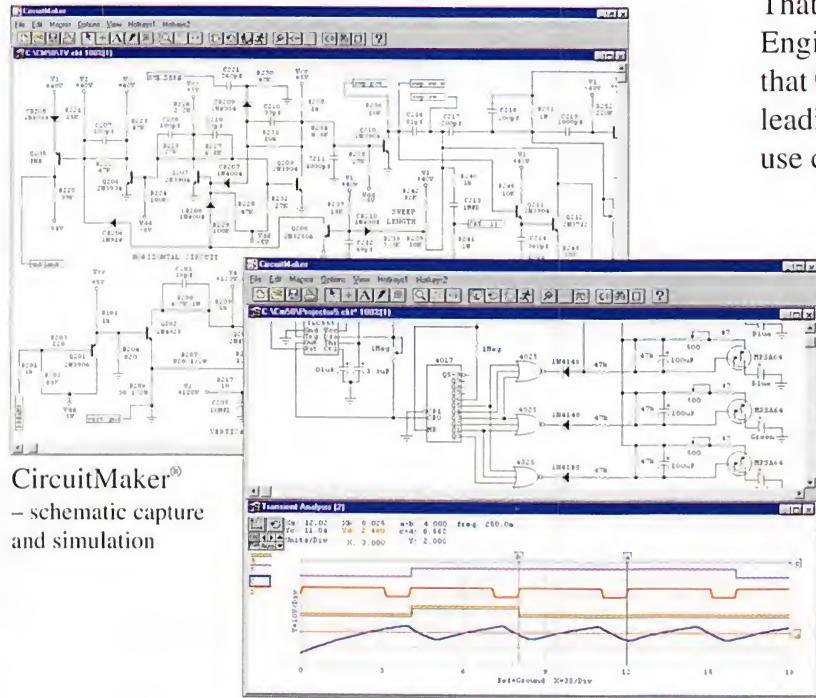


\$4.50 U.S.  
\$4.99 CAN.

 A GERNBSACK  
PUBLICATION

# Professional Power

## *at a hobbyist price.*



CircuitMaker<sup>®</sup>  
— schematic capture  
and simulation

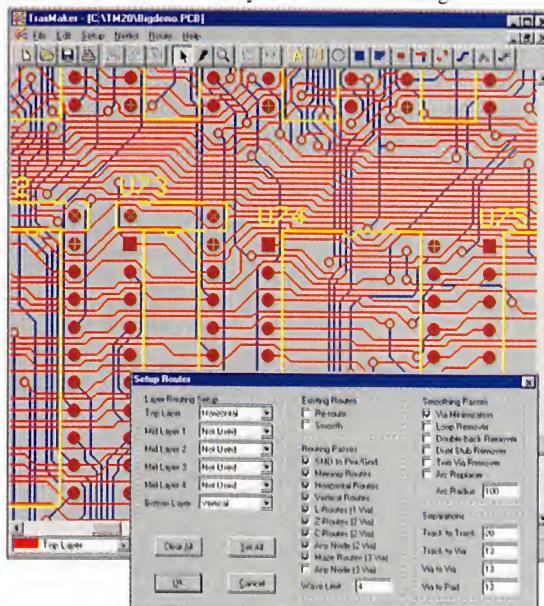
That has been our philosophy at MicroCode Engineering since 1987. So it's no surprise that **CircuitMaker** and **TraxMaker** are the leading software tools for affordable, easy-to-use circuit design, simulation and PCB layout.

**QUICKLY DESIGN** analog, digital or mixed analog/digital circuits with CircuitMaker's advanced schematic features. You fully control the wiring, device placement, annotation and colors. And the Symbol Editor and macro features let you create unlimited custom devices and symbols.

**SIMULATE and ANALYZE** what you create – try all the "what if" scenarios with:

- Fast, proven 32-bit SPICE 3f5/XSpice simulator
- True mixed analog/digital simulation
- Fully interactive digital logic simulation
- 4,000-device library
- AC Frequency Analysis
- DC Operating Point Analysis
- DC Transfer Function
- Transient Analysis
- Step Function – step component values and sources over a user-definable range

TraxMaker<sup>®</sup> – PCB layout and autorouting



**TAKE MEASUREMENTS** at any point in the circuit with a click of the Probe tool. Results appear immediately on virtual instruments like the Digital Oscilloscope, Curve Tracer, Digital Multimeter and Bode Plotter. No other simulator lets you take measurements as quickly and easily as CircuitMaker.

**COMPLETE** the design process with TraxMaker, a professional printed circuit board layout program with built-in autorouter. Import netlists from CircuitMaker and other schematic programs, or design boards from scratch.

- Includes autorouter, auto component placement and Design Rules Check
- Supports up to 8 copper layers, board sizes up to 32 x 32 inches
- Surface mount and through-hole components from a customizable library
- Outputs your PCB as a Gerber file, Excellon N/C drill file, and prints to any Windows-selectable printer or plotter

**RELY ON** free technical support from qualified engineers. And every MicroCode product is backed by our **30-day Money-Back Guarantee** if it does not live up to your expectations.

**Call 800-419-4242 for more information and free demos**

(or download from [www.microcode.com](http://www.microcode.com))

CIRCLE 171 ON FREE INFORMATION CARD

<b>CircuitMaker Version 5</b>	<b>\$299</b>
<b>TraxMaker Version 2</b>	<b>\$299</b>
<b>CircuitMaker Design Suite™</b> (CircuitMaker and TraxMaker)	<b>\$549</b>

# CONTENTS

MARCH 1998

## ON THE COVER

## 33 BUILD A HIGH-PERFORMANCE LOGIC ANALYZER

If you've done any amount of digital-circuit troubleshooting, you no doubt know how valuable an instrument a logic analyzer can be. But if you've ever shopped for an analyzer, you also know how expensive a top-flight unit can be. Yes, there are a number of lower-cost PC add-ons that can be bought or built, but most have limitations; either they have a low sampling rate or have only a few sampling channels. That is until now. This month's cover story introduces a PC-based logic analyzer that features a 40-MHz maximum sampling rate, 16 channels, and more. Even better, it's expandable. — *Robert G. Brown*



## TECHNOLOGY

## 23 PROTOTYPE

Miniature unmanned aircraft, a radar flashlight, analyzing blood disorders, smartcard ICs, and more.



## 44 MAINTAINING YOUR OWN PC

These simple steps can ensure the health of your personal computer and your valuable data.

— *Stephen J. Bigelow*

## 51 RESTORING A "REEL" RECORDER

This month we show you the first steps in bringing your cherished treasure back to life.

— *Phil Van Praag*



As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) March 1998. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$19.97, Canada \$27.79 (includes G.S.T., Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$28.97. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.50. © 1998 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

## BUILD THIS

**59** **BUILD A "HOME-BREW" TEMPERATURE CONTROLLER**  
One key to making your own beer and wine is precise temperature control, and this unit makes achieving that a snap. — *David W. Boertjes*



## DEPARTMENTS

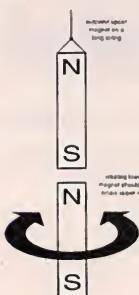
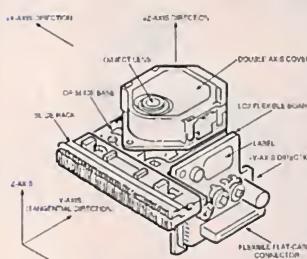
**13** **EQUIPMENT REPORT**  
RadioShack AccuWeather personal weather station..

**16** **COMPUTER CONNECTIONS**  
Pilot graphing, Small C, e-mail, and more. — *Jeff Holtzman*

**18** **SERVICE CLINIC**  
Servicing CD players and CD-ROM drives.  
— *Sam Goldwasser*

**27** **AUDIO UPDATE**  
Using the capacitance-substitution box. — *Franklin J. Miller*

**62** **TECH MUSINGS**  
FM transmitters, understanding the Faraday disc, and more.  
— *Don Lancaster*



## AND MORE

**3** **NEW PRODUCTS**

**4** **EDITORIAL**

**5** **NEW LITERATURE**

**6** **Q&A**

**15** **LETTERS**

**116** **ADVERTISING INDEX**

**116** **ADVERTISING SALES OFFICE**

# Electronics NOW®

Hugo Gernsback (1884-1967) founder

**LARRY STECKLER**, EHF, CET,  
Editor-in-chief and publisher

**ADRIA COREN**, Vice-President

**KEN COREN**, Vice-President

**EDITORIAL DEPARTMENT**

**CARL LARON**, editor

**JOSEPH J. SUDA**, technical editor

**JULIAN S. MARTIN**, associate editor

**EVELYN ROSE**, assistant editor

**TERI SCADUTO**, assistant editor

**MICHAEL A. COVINGTON**, N4TMI  
contributing editor

**SAM GOLDWASSER**, service editor

**JEFFREY K. HOLTZMAN**,  
computer editor

**FRANKLIN J. MILLER**,  
audio editor

**DON LANCASTER**,  
contributing editor

**DEBBIE CYBULA**, editorial assistant

**ART DEPARTMENT**

**ANDRE DUZANT**, art director

**RUSSELL C. TRUELSON**, illustrator

**PRODUCTION DEPARTMENT**

**RUBY M. YEE**, production director

**KATHRYN R. CAMPBELL**,  
production assistant

**KEN COREN**,  
desktop production director

**LISA BAYNON**, desktop production

**MELISSA GIORDANO**, desktop production

**CIRCULATION DEPARTMENT**

**TERESA LOMBARDO**,  
circulation manager

**GINA GALLO**,  
circulation assistant

**REPRINT DEPARTMENT**

**MARIE FALCON**, reprint bookstore

Typography by Mates Graphics

**Electronics Now** is indexed in *Applied Science & Technology Index*, and *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*.

Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

**Advertising Sales Offices listed on  
page 116.**

Electronics Now Executive and  
Administrative Offices  
**1-516-293-3000.**

Subscriber Customer Service:  
**1-800-999-7139.**  
**7:00 AM-6:00 PM Monday-Friday MST**

VISIT US ON THE INTERNET AT:  
[www.gernsback.com](http://www.gernsback.com)



Audit Bureau  
of Circulations  
Member



# NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## Interactive Car Navigation System



CIRCLE 20 ON FREE INFORMATION CARD

Easy to install and use, Philips Car Systems' CARiN 520 expands consumer access to digital vehicle-navigation technology that previously was available only through luxury automobile accessory packages. Including a navigation computer, LCD monitor, remote control, and installation components, the system can be installed by a professional in as little as two hours.

CARiN's easy-to-use remote and route selection, automatic alternate routing, CD-ROM mapping, and emergency features combine into an accessory that makes driving safer and more enjoyable. The Philips system is one of the only systems employing dead reckoning as its primary navigational tool. Dead reckoning uses an integrated gyroscope and patented CD-ROM database to pinpoint the vehicle's location, and then checks itself with the Global Positioning System (GPS) for accuracy. That method eliminates problems caused by interference in places such as urban canyons or when a user is caught between satellite links.

Drivers receive both visual and audio directions through a five-inch LCD color

display. They can choose from various options, including a male or female voice in one of six languages; an optional flexible stalk mount, which allows placement in several locations within the vehicle; and background monitor colors that can be changed from orange-red to green to blue.

CARiN 520 is controlled by an illuminated IR remote that may be handheld or permanently mounted. A personal-destination memory can store up to 100 addresses; the most recent 10 addresses are stored automatically. Seven U.S. regional CARiN CD-ROM maps are available.

About the size of a vehicle CD player, the navigation computer is sufficiently compact to mount under the rear deck, in the trunk, beneath a seat, or on the floor of the cargo area. The CARiN 520 retails for \$1999, plus installation and CD-ROM mapping.

**Philips Car Systems**  
64 Perimeter Center East  
Atlanta, GA 30346-6401  
Tel: 770-821-2400  
Fax: 770-821-3212

## Temperature Logger

The low-cost data-logger family from AEMC is unique because they require no user set up and are able to automatically adjust the scale and sample rate to optimize to the recording. The Simple Logger, a temperature logger, has recently been added to this family.

One-button operation makes the data logger extremely easy and quick to use. Temperature inputs can be done either through an internal thermistor or an external thermistor probe. The unit is directly compatible with industry-standard 10,000-ohm thermistor probes. A 9-volt battery provides one year operation.



CIRCLE 21 ON FREE INFORMATION CARD

Included with the logger is Windows-based software, which allows plotting, statistical analysis, text annotation, and zoom capability. Graphs and tabular listings can be printed, or the graphs can be pasted directly to the Windows clipboard for insertion into other programs. Stored files can be imported by all popular spreadsheet, datasheet, and word processing programs. The Simple Logger stores over 8000 data points, and the device has a built-in RS-232 port for downloading.

The data logger's compact size ( $2\frac{7}{8} \times 2\frac{5}{8} \times 1\frac{5}{16}$ ) makes it easy to take anywhere. Depending on the model, it is priced from \$149 to \$159, with the software and the interface cable included.

*(Continued on page 22)*

## Accredited B.S. Degree in Computers or Electronics

by studying at Home

**Grantham College of Engineering**  
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

**NEW**  
-Electronics Workbench Professional 5.0  
included in our B.S.E.T. curriculums  
-Approved by more than 200 Companies,  
VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial

**1-800-955-2527**

**http://www.grantham.edu**

# **GCE**

*Your first step  
to help yourself  
better your future!*



**Grantham College of Engineering**  
34641 Grantham College Road  
Slidell, LA 70460-6815

Some Say Watching Tropical  
Fish Lowers Blood Pressure  
& Relieves Stress...



They Could Be On To  
Something.



Discover the Caribbean aboard a Tall Ship.  
6 & 13 day adventures from \$650.  
For more information call your travel agent  
or 1-800-327-2601.



**Windjammer  
Barefoot Cruises**

P.O. Box 190120, Dept. 5569 Miami Beach, FL 33119

CIRCLE 132 ON FREE INFORMATION CARD

# **EDITORIAL**

## **The Uncertain Face of TV**

The buzzword at this year's Consumer Electronics Show (which will have passed by the time you read this) is slated to be DTV, or digital television. That's because manufacturers will be unveiling their first products for the new digital broadcasting standard at that show.

For those of you who haven't heard about it, or didn't read my Editorial last July ("The New Face of TV"), DTV is scheduled to completely replace the existing NTSC broadcasting standard by 2006, with the first digital broadcasts to begin this fall. Yet, with all this impending activity and change, no one is really sure what shape DTV will take.

Many assume that DTV automatically means HDTV. It doesn't. Another possible use of DTV—and the increased bandwidth broadcasters received to accommodate it—is multicasting: breaking up the signal into multiple standard-definition TV channels.

The problem for broadcasters is that regardless of which way they go, DTV is going to be an expensive proposition. Costs for converting each station is estimated at between \$2 and \$14 million dollars. And no one is quite sure if those costs are going to be recovered in the short term regardless of the type of DTV broadcast. Some station owners are even wondering if it makes any sense for them to stay in business at all.

Remember that almost all station revenues are derived from advertising. Will advertisers be willing to shell out extra dollars for their spots to run in HDTV? Without sufficient advertising, will stations be willing or able to broadcast a significant amount of HDTV material? If there is limited or no programming, will consumers spend the \$3000 or so that the first-generation HDTV sets might cost? And, if there are few sets in the hands of consumers, will advertisers be willing to have their spots air during HDTV broadcasts at all?

If broadcasters go to multicasting, where will they get the programming to fill the extra channels, and what will they have to pay for it? The thought of premium subscription services has been tossed about, but the political backlash that such a use would generate—remember, the stations received their extra spectrum at no charge—likely makes that possibility a remote one for the time being.

But even free multicasting faces opposition from some quarters. In fact, this past fall Congress grew livid when some networks and broadcasters indicated that the multicasting approach might be the way to go. During hearings, the reaction was so strong that executives were forced to backtrack somewhat on that possibility.

To illustrate how much confusion and uncertainty exists, at those same hearings FCC Chairman Hundt went on record to say that he felt that multicasting offered a good use of the spectrum as it would offer a free and viable alternative to cable TV.

In short, the only thing certain about DTV is uncertainty. We'll keep you posted.

Carl Laron  
Editor



# NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## The Microcontroller Beginner's Handbook

by Lawrence A. Duarte

Prompt Publications

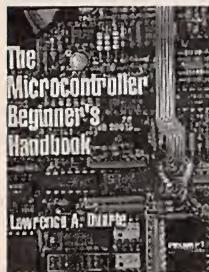
2647 Waterfront Parkway, East Drive  
Suite 300

Indianapolis, IN 46214-7267

Tel: 800-428-7267

Web: [www.hwsams.com](http://www.hwsams.com)

\$18.95



CIRCLE 343 ON FREE INFORMATION CARD

Today, microcontrollers are found in everything from microwave ovens and telephones to cars and toys. All elements of their use, including such industrial considerations as price vs. performance, firmware, and re-

sistors, are discussed in the book. Third-party hardware and software development tools are also analyzed, with emphasis placed on new-project design. Everyone from the novice to the more experienced designer will find a wealth of information on understanding, repairing, and building devices incorporating microcontrollers.

In over 224 pages—profusely illustrated with tables, schematics, photos, diagrams, and program listings—this technology, starting with the basics, continuing through project construction, and ending with practical design considerations, is thoroughly covered. All that's necessary to begin with is a knowledge of a first-year electronics course. Readers with an elementary grasp of electronics terms will find the material right at their level. Even those experienced with microcontroller use will find new ideas in this material.

After reading the handbook, the builder will be able to design, write, and build units that use a microcontroller. The first project, at a beginner's level, is the PK Tester (originally published in our

sister publication, *Popular Electronics*, May 1995)—a device that tests for psychokinetic (PK) ability. Project difficulty increases as you progress, and the last, more advanced, project is a video-output thermometer that displays indoor and outdoor temperature on a standard television screen.

The Microcontroller Beginner's Handbook concludes with useful appendices: Appendix I contains listings of the firmware; Appendix II has parts lists for all the projects, organized by chapter; and Appendix III provides vendor information, including the type of products supplied.

## Netizens: On the History and Impact of Usenet and the Internet

by Michael Hauben and Ronda Hauben

IEEE Computer Society Press

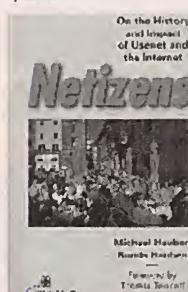
10662 Los Vaqueros Circle

Los Alamitos, CA 90720

Tel: 800-CS-BOOKS or 714-821-8380

Web: <http://computer.org>

\$28.95



CIRCLE 344 ON FREE INFORMATION CARD

As a result of the online research the authors conducted, this book looks at the creation and development of the Internet through the eyes of its builders and users.

A must-read history of the pioneering vision and actions that made the Net possible, *Netizens* explains what

**BooksNow** To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (702) 258-3338 ask for ext. 1456 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>

makes the Internet tick. Taking us on a step-by-step journey through the past, the present, and the future of the participatory global computer network, the book provides a detailed examination of the Internet's construction, examining its technical and social roots.

The authors focus on the role of Net citizens, or Netizens, who make positive contributions to the Net. Questions such as how they have impacted the future of our entire society, how to guide the future extension and growth of the Internet, and how it can be made more widely available are discussed. In addition, the economics of computer and Internet development is examined.

At the end, there's a glossary of acronyms, a bibliography, and an appendix that presents a declaration of Netizens' rights. This 300-plus page book is a useful reference for anyone interested in the Internet.

## Telecommunications: Glossary of Telecommunications Terms

Government Institutes

4 Research Place

Rockville, MD 20850

Tel: 301-921-2355

Fax: 301-921-0373

E-mail: [giinfo@goinst.com](mailto:giinfo@goinst.com)

Web: [www.goinst.com](http://www.goinst.com)

\$119 plus \$6 S&H



CIRCLE 345 ON FREE INFORMATION CARD

Over 5000 technical definitions are covered on this comprehensive CD-ROM including computer and data communications (hardware and software):

fiber optics; facsimile; frequency topics; Internet; ISDN; LANs; WANs; modems; multiplexing; network arrangement and architecture; cellular mobile, radio and satellite communications; security issues;

(Continued on page 14)



# Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

## Regenerative Correction

**Q** Regarding the regenerative AM radio in the July 1997 installment of "Q&A" (on page 8), shouldn't the transistor be an NPN? The diagram shows a PNP. Also, what gauge of wire should L1 be wound with, and what is the length? Would a 250- $\mu$ H ferrite bar coil work? — Pete Haas, Kent, OH

**A** You're right—the 2N3904 transistor is an NPN even though the PNP symbol appears in the diagram. (Your author does his own drafting and can't blame anybody else for this one.) The coil is not critical; we used 36 turns of No. 28 magnet wire close-wound on a 4-inch spool that had originally held gift-wrapping ribbon. Any high-Q coil of about 250  $\mu$ H should work just as well.

## Regenerative Troubleshooting

**Q** I tried using an LM386 audio amplifier with the regenerative receiver presented in July, and it started "motorboating" and displayed all sorts of spurious oscillations. Could you provide a simple circuit to drive a speaker from the regenerative receiver by means of an LM386 or an MC34119P?

And, if possible, I would like to see a schematic of a simple superregenerative receiver to receive aircraft frequencies (117-136 MHz). Thanks. — L. H., Canoga Park, CA

**A** Taking the easy question first, plans for a VHF superregenerative receiver are given in the *ARRL Handbook for Radio Amateurs, 1998 Edition*, together with an explanation of how it works and the special "ugly bug" construction technique required. You can get that book from the American Radio Relay League, Newington, CT 06111.

Now for the motorboating problem.

As you've discovered, regenerative receivers are very sensitive to power-supply coupling. For best results, power the receiver from one battery and the audio amplifier from another. If that's not possible, you can try isolating the two circuits as shown in Fig. 1. There are two bypass capacitors on each side because large capacitors aren't efficient at high frequencies.

Also, the LM386 itself is prone to oscillation at radio frequencies, and the LM386 circuit that you sent in (shown in Fig. 2) looks like it has too much gain. Regenerative receivers themselves have tremendous gain and don't need much audio amplification after them. Try

removing C2 and R2, and make sure C3, C4, C6, and R3 are as close to the chip as possible.

Because of its low-impedance input and bridged output, the MC34119P might be a better choice for this application. Figure 3 shows Motorola's recommended circuit. For best results, use a 32- or 64-ohm speaker.

## EPROMS Demystified

**Q** I am new to electronics and would like to learn more about EPROMs and EEPROMs. Do they program through a language, or does the user have to plot the actual internal wiring? — G. G., Bradenton, FL

**A** Let's distinguish three different devices: (1) ROMs (read-only memories); (2) microcontrollers, which are one-chip computers that include some form of ROM, together with CPU and input-output ports; and (3) programmable logic devices (PLDs), which are arrays of gates whose interconnections can be programmed by the user.

ROMs, or read-only memories, simply store information. A ROM chip has sixteen to twenty address inputs and eight data outputs. Information is repre-

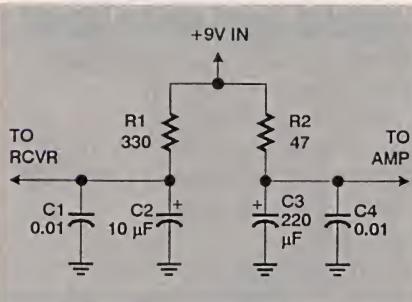


FIG. 1—HERE'S HOW TO POWER both your regenerative receiver and an audio amplifier from a single supply.

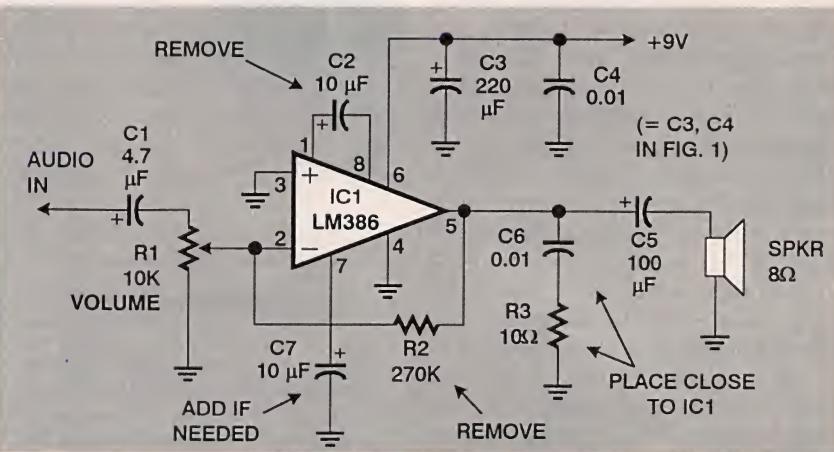


FIG. 2—FOR USE WITH A REGENERATIVE RECEIVER, the modifications shown to the reader's circuit will greatly improve stability.

sented as ones (+5V) and zeroes (0V).

The address inputs identify locations within the ROM. For example, 0001011000110111 could be an address that picks out one of the 65,536 memory locations on the chip. At each address, the ROM stores eight bits of data. When you apply the address to the

address inputs, the data stored at the corresponding location appears on the eight output lines. It could be any bit pattern whatsoever.

ROMs are usually used to store programs for computers, but they have some other uses as well. By connecting the address lines to a binary counter, you can step through all the addresses in sequence. You could use the output to produce patterns of blinking lights or messages in Morse code.

ROMs come in several types: mask-programmed (programmed at the factory), OTP (one-time-programmable, which means you can program them but not erase them), EPROM (erasable with UV light), and EEPROM (electrically erasable programmable read-only memory). Flash memory is a variety of EEPROM where the whole chip has to be erased at once.

To program an EPROM, you use your PC to create a file of bits (or of hexadecimal digits that represent them); then download this file into the EPROM through a programmer.

Some good, inexpensive EPROM programmers include the EZ-EP from

M<sup>2</sup>L Electronics (3526 Jasmine #4, Los Angeles, CA 90034; Web: [www.m2l.com](http://www.m2l.com)), and the Pocket Programmer from Intronics (Box 13723, Edwardsville, KS 66113); both are priced under \$200. In a higher price range, the Needham's EMP-20 (about \$450) gets good reviews. It's available from General Device Instruments; Tel: 408-241-7376; Web: [www.generaldevice.com](http://www.generaldevice.com).

To learn more about ROMs, see two articles in the November 1995 issue of *Electronics Now*, "Low Cost EEPROM Programmer" and "Five Easy EEPROM Projects;" reprints are available from the Reprint Bookstore (see the sidebar "How to Get Information About Electronics"). See also *Experiments with EPROMs*, by Dave Prochnow (McGraw-Hill, 1988).

The bits in an EPROM don't mean anything; they're just stored information. If the EPROM is connected to a CPU (central processing unit), the CPU will read the EPROM's contents and interpret it as instruction codes. If the CPU and EPROM are on a single chip, it's called a microcontroller. To program a microcontroller, you first write your

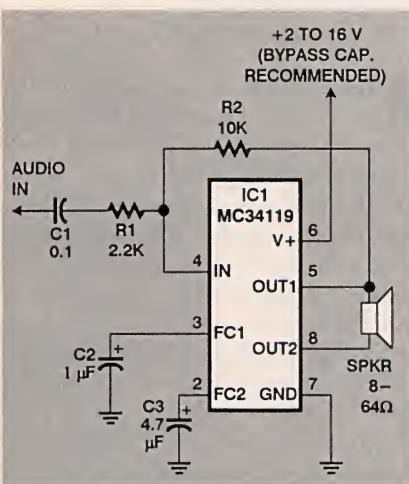


FIG. 3—MOTOROLA'S MC34119 AUDIO AMP has a low input impedance, making it easy to work with. Note that capacitor C3 is often unnecessary.

## ProtoLab 4.0

Easy-to-use circuit simulation package from the leader in electronic prototyping.

- Designed for use with Windows® 95
- Low Cost - \$49.95
- Design circuits instantly while choosing from a complete list of active and passive components
- Analyze circuits using built-in test instruments.



**GLOBAL SPECIALTIES**  
SOFTWARE

INNOVATIVE PRODUCTS. UNSURPASSED QUALITY.  
1-800-572-1028 • For a demonstration, visit:  
[www.globalspecialties.com](http://www.globalspecialties.com)

Windows®95 is a U.S. registered trademark of Microsoft Corporation.

## HOW TO GET INFORMATION ABOUT ELECTRONICS

**On the Internet:** See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups `sci.electronics.repair`, `sci.electronics.components`, `sci.electronics.design`, and `rec.radio.amateur.homebrew`. "For sale" messages are permitted only in `rec.radio.swap` and `misc.industry.electronics.marketplace`.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitec.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online.

**Books:** Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

**Copies of past articles:** Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1993 only) are available from our Claggk, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

**Electronics Now** and many other magazines are indexed in the *Reader's Guide to*

program in assembly language, C, or BASIC; then test it in a simulator on your PC; and finally download it into the microcontroller with equipment much like what you'd use to program EPROMs. Back in January and February 1994, we published plans for two microcontroller programmers. Many commercial EPROM programmers also program microcontrollers.

Programmable logic devices (PLDs) are arrays of gates whose interconnections you can either destroy (by blowing

*Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

**Service manuals:** Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549 Tooele, UT 84074.

**Replacement semiconductors:** Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

**Hamfests (swap meets) and local organizations:** These can be located by writing to the American Radio Relay League (Newington, CT 06111; <http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

tiny fuses) or create (by melting "anti-fuses" to make connections). Their main advantage is that, because they consist only of gates, they respond to their inputs almost instantly rather than executing instructions one at a time like a microcontroller. PLDs are often used in address-decoding circuits inside computer peripherals. There are languages for describing the interconnections concisely. We covered PLDs in detail in the May 1994 issue, including plans for a programmer.

## Making It Talk

**Q** We have many kinds of low-cost talking toys. Does it take a lot of expensive equipment to program these devices or can I, using ordinary electronic parts, construct a solid-state device to play my message when triggered? I could then have a talking doorbell, a talking burglar alarm, and more! — H. D. K., Philadelphia, PA

**A** Voice-recording chips and modules are as close as your local RadioShack store. For example, the ISD1000A stores up to 20 seconds of audio, which can be divided into several messages. The storage is non-volatile—the chip doesn't lose its memory when powered off. No special programming equipment is required; audio amplifiers for both recording and playback are on the chip.

These chips are made by Information Storage Devices (ISD), Inc., 2045 Hamilton Ave., San Jose, CA 95125; Tel: 408-369-2400; Web: [www.isd.com](http://www.isd.com). You can view data sheets online at their Web site and learn more about their products.

## RFI Emergency

**Q** My neighbor's CB interferes with my cordless phone, regular phone, TV speakers, and even new multimedia speakers. What can I do? — Name withheld

**A** If only one piece of audio equipment were receiving interference, we'd suspect the problem might be on the receiving end. There is, unfortunately, no law that requires stereos, TVs, or telephones to block out radio signals, and some of them are shoddily built.

The fact that you're getting interference in so many different pieces of equipment strongly suggests that the problem is with the transmitter. Your neighbor may have defective equipment or an improperly installed antenna, or he may be running an illegal amount of power. CB is designed for short-range communication, but, unfortunately, some CBers get a kick out of blanketing North America with their signal, using a 1000-watt linear amplifier instead of the legal 4 watts. Some people just want to have the whole continent to themselves!

You should call the nearest Federal Communications Commission (FCC) field office; in your case, that's Atlanta at 770-279-4621. The FCC has imposed heavy fines on CBers who run illegal

# 5 Reasons why NRI Training in PC Servicing puts the emphasis on you

Real-World Technology...  
New Course Features...  
Hands-On Experience...  
Service...  
Convenience



## Real-World Technology

- You get a customized 200 MMX Pentium® computer to train with and keep.
- You use your new computer's 33,600 baud or faster fax/modem in conjunction with Netscape Navigator™ Web browser software.
- You train with a digital multimeter, for quick and easy testing.
- You learn to take advantage of PC communications and the Internet.

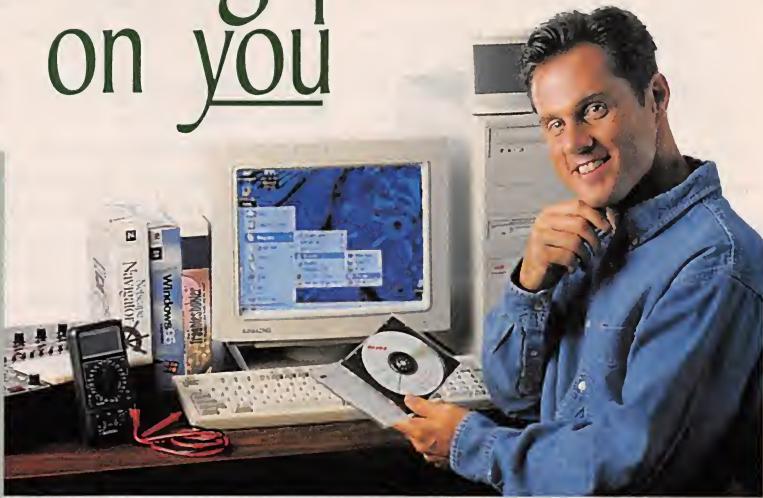
## New Course Features



- You can move up to an even more feature-packed computer system at special student prices, with NRI's new PC Options Plan.
- You get a free upgrade to Windows 98.
- You receive an exciting multimedia CD-ROM from Norton Interactive.
- You gain computer aided electronics troubleshooting experience with diskettes covering four key areas: AC electronics, DC electronics, semiconductors, and electronic circuits.

## Hands-On Experience

- You establish a solid foundation with a review of basic electronics.
- You learn how to troubleshoot and maintain today's sophisticated PCs.
- You train with the NRI Discovery Lab to experience circuit design and modification.
- You explore the features you've chosen for your computer, from memory chips to high-speed CD-ROM drive.
- You explore the applications and accessories of Windows 95, then move up to new Windows 98.



## Service

- You work one-on-one with an experienced instructor.
- You can call NRI's TeleService hotline, for 24-hour answers to your questions.
- You get immediate feedback with NRI's TeleGrading service, featuring 24-hour exam grading.
- You can continue receiving advice and feedback from your instructor after you graduate.
- You can turn to NRI for letters of recommendation, transcripts, tips on resume writing, and more.

## Convenience

- You don't need any experience to get started.
- You study at home, at your own pace.
- Your company may pay for all or part of your tuition.
- You can reach your instructors easily by mail, phone, fax, or online.
- You can tailor your training to meet your immediate interests or professional goals.



**CALL 1-800-321-4634 FOR FREE CATALOG!**

**NRI**

**Schools** 4401 Connecticut Avenue,  
NW, Washington, DC 20008

**Ask for Ext. 3000**

Check one FREE catalog only

- PC SERVICING
- Game Programming Fundamentals
- Troubleshooting Personal Computers
- Computer Programming
- TV/Video/Audio Servicing

- Desktop Publishing with PageMaker
- Networking with Windows NT
- Bookkeeping and Accounting
- Mastering Microsoft Office
- Multimedia Programming

Name

(please print)

Age

Address

City

State

Zip

A Division of The McGraw-Hill Companies

Accredited Member, Distance Education and Training Council

0003-0398

amps. Your local ham-radio club may also be able to help; even though CB and ham radio are completely different services, the local hams will probably have the equipment and know-how to help you find out what's going on.

Finally, encourage your neighbor to get a ham license; that will allow him to use 1500 watts legally, provided he acquires the technical skill to do so without causing problems.

## Computer Interferes With TV

**Q** What can be done to get rid of interference on my TV when I turn on my computer?

— B. G., Palmdale, CA

**A** Several things. Plug the TV and the computer into separate outlets. Put a toroid (RadioShack 273-104) on the computer's power cord as close to the case as possible. Use an outdoor TV antenna or cable TV; an indoor antenna can't avoid picking up stray RF from a computer right next to it. Finally, watch a local TV station; if you tune in a station 50 or 100 miles away, the signal will be so weak that it is never totally free of interference.

## Antenna Trick

**Q** I have just purchased an AM/FM radio that is not sensitive enough to pick up an FM station of my choice. The radio has only a whip antenna, with no antenna terminals on the back of the receiver. What can I do?

— H. F., Orleans, MA

**A** Since you've just purchased it, the first thing to do is compare it with another unit of the same make and model; transistors vary in sensitivity, and you may have gotten a weaker-than-normal receiver. But given the amount of time it takes us to answer questions, it's probably too late to do that now.

An antenna trick that we've used with success is to extend the whip straight up, 30 inches long. Run another 30-inch whip, made of wire, straight downward; and connect it, not to the antenna, but to the outer ring of the headphone jack, which is grounded. You'll then have the receiver at the center of a vertical dipole. Whips longer than 30 inches are less efficient because their resonant frequency is below the FM band.

## Surge Protector Question

**Q** According to the manufacturer's catalog, an RS Electronics 238-845 surge protector is recommended for installation on telephone lines. Can I install it across a 230-volt power line? — M. P. J., Dammam, Saudi Arabia

**A** No. Telephone lines carry about 50 volts (with surges to 200), delivered through a resistor that limits current to less than 1 ampere. Besides the higher voltage, an AC power line can deliver much heavier current, and there's a real risk that your surge protector would go up in flames. Never connect anything across the power line unless you are sure it is safe.

## Modify CD-ROM?

**Q** While shopping for an external CD-ROM drive for my old laptop, I found an external 4x-speed unit for \$350, but internal 12x-speed units were on sale for \$59. There has to be a way I can rig up the internal drive to operate from the PC Card (PCMCIA) slot or the parallel port. Any ideas? — Anonymous, Portage, IN

**A** If the internal drive happens to have a SCSI interface, you can get a PC Card SCSI adapter and hook it up; of course, you'll also need a power supply and enclosure. If it's IDE (more likely), things aren't so easy; besides building an interface circuit, how much of Windows 95 do you want to rewrite? Still, someone may have solved the problem. Readers?

## TV Service Tip

**Q** Regarding a question in November's installment of "Q&A," tell W. A. E., whose TV intermittently loses brightness, to try tapping the base of the CRT gently with a long wooden stick or other insulated rod. It is common for older CRTs to develop a cathode-to-grid short. There is a technique for burning out such shorts; but if he can't tap it out, I suggest he treat himself to a new TV. — Tom Baasch, Ridge, NY

**A** Thanks! Of course, no one should work near an energized CRT unless they are familiar with appropriate high-voltage precautions and also have a healthy respect for the risk of breaking the glass.

## More Dimmer Interference

**Q** Here's a follow-up to September's Q&A concerning AM radio interference from light dimmers; I've been experiencing the same problem for years. After reading the article, I bought new dimmers and installed them, but still had the same problem. I called the manufacturer of the dimmer, but there was no help forthcoming except a suggestion to install a filter on the power cord of the receiver. I tried one of these filters a few years back, but to no avail. What else can I do? — W. W., St. James, NY

**A** If it were us, we might try different brands of dimmer, one at a time—it sounds like your new dimmers weren't appreciably different from the old ones. Also, you haven't indicated how severe the problem is. Some interference on weak signals will always be there; the receiver can't distinguish electrical noise from parts of the AM signal. On the other hand, if you can't receive local stations clearly, something is definitely wrong.

Have you tried a different radio? If a battery-powered radio doesn't suffer interference, try filtering the line cord of your line-powered radio—not by clamping a toroid on it (which would suffice at higher frequencies), but rather by plugging the radio into a power line filter such as RadioShack's 15-1111.

Dimmers are inherently noisy devices; the ultimate solution, if you need to hear weak AM signals, may be to simply do without them.

## Writing to Q&A

That's all for this month. As always, we welcome your questions; please write to: "Q&A," Electronics Now Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication). If you are asking about a circuit, please include a complete diagram. Due to the volume of mail, we regret that we cannot give personal replies.

EN

### ANTIQUE RADIO CLASSIFIED

Free Sample!

Antique Radio's  
Largest Circulation Monthly  
Articles, Ads & Classifieds.



6-Month Trial: \$19.95. 1-Yr: \$38.95 (\$55.95-1st Class).  
A.R.C., P.O. Box 802-L19, Carlisle, MA 01741  
Phone: (508) 371-0512 VISA/MC Fax: (508) 371-7129



# EQUIPMENT REPORT

RADIOSHACK ACCUWEATHER WEATHER STATION

*Monitor every aspect of the weather with the RadioShack AccuWeather personal weather station.*

CIRCLE 15 ON FREE INFORMATION CARD



**T**he weather is important to different people for different reasons. Sometimes rain is good and sometimes it's not. Snow means a treacherous trip to work for many people, while others make money plowing it away. Kids certainly don't mind snow when school is closed because of it. On a more practical note, knowing what the temperature is outside before leaving for work makes it easier to select the right jacket.

Some people want to know more than just the temperature. For these people, RadioShack's *AccuWeather* personal weather station might just provide enough of a forecast. The compact unit can display indoor and outdoor temperature, humidity, and dew-point readings plus outdoor wind speed and direction, barometric pressure, wind chill, and rainfall. The highest and lowest readings for all measurements are stored in memory, and an alarm can be set in any mode to trigger when measurements go beyond user-specified limits. The system also keeps track of the time. *AccuWeather* even has a serial output that can connect to a computer. Software is included that lets you keep track of the weather readings as well as log data to a hard disk.

Although *AccuWeather* comes fully assembled, it does require some work installing the outdoor sensors and running the cables to the control unit indoors. *AccuWeather* (Model No. 63-1015) sells for \$299.99 at any RadioShack store. That price includes everything you

need: the control unit, three outdoor sensors, and all the cabling. If there is no RadioShack store near you, just call 800-THE-SHACK.

## Setting It Up

*AccuWeather* consists of a small control unit that mounts indoors. It measures approximately 7 inches wide by 4 1/4 inches tall by 1 1/4 inches thick. A backlit LCD displays readings one mode at a time. The display can be set to show one of the following: the time and date, indoor and outdoor temperature, indoor and outdoor humidity, indoor and outdoor dew point, barometric pressure, wind speed and direction, wind chill, or rain accumulation. It can also be set to cycle through all modes, displaying each reading for five seconds.

Sensors for wind speed and direction, rainfall, and temperature/humidity must be installed outdoors. Each sensor has a 30-foot cable attached to it with a modular connector on the free end. The indoor sensors are contained inside the control unit. An AC adapter supplies power, and eight AAA backup batteries will power the weather station for up to 36 hours in the event of a power outage.

Installing the outdoor sensors takes a few hours. Before you can begin, though, some planning is required. First you have to decide where you want the control unit to be located, because you can't move it once you've installed the outdoor sensors and run the cables. Each outdoor sensor

has a permanently attached 30-foot cable that cannot be lengthened. The cables have to reach from the sensors through a window or opening in an outside wall of your house to a connection box indoors. A 10-foot cable runs from the connection box to the control unit, so the sensor wires can enter the house up to 10 feet away from where you want the control unit. Because the control unit contains the indoor sensors, it should not be located near a heat source or cooling vent, or where it might be unusually humid.

If you can't run cables through a window without damaging them, it's best to install a length of PVC pipe through an outside wall and pass the cables through it. The pipe should be angled down toward the outside so that water will not seep inside. Pack the ends with putty that never hardens—that way you can always move the sensors if you have to without destroying the wires.

The anemometer assembly is designed to mount on an antenna mast away from any obstructions that would interfere with wind flow. The anemometer is a plastic arm with a wind vane on the top and wind cup on the bottom of one end. The arm is secured to the antenna mast with a pair of included U-bolts. RadioShack can supply an antenna mast and chimney mounting hardware. The anemometer arm must be mounted so that it points south—that calibrates wind direction with the control unit.

The rain gauge contains a two-sided flip-flop water ladle connected to a switch. A screened funnel directs rainfall into the ladle and causes it to toggle back and forth. The rain gauge should be mounted where it is level and blocked from crosswinds. It should not be blocked from above so that full rainfall will be collected, and it should be accessible so that debris caught in the screen can be removed.

The temperature/humidity sensor is factory sealed with an attached cable. The sensor should be mounted away from

direct sunlight and wind in a place where snow and ice will not collect.

### Be Your Own Weatherman

With all the sensors attached and power applied, AccuWeather lights up with weather data. The time and date have to be set when it's first powered up. The controls are easy to use, and they allow you to change display modes for different weather readings. You can also set the display units, say temperature between Fahrenheit and Celsius, wind speed in mph or kph, and so on. You can also recall daily highs and lows.

If you have a 386/33 or better PC and Windows 3.1 or higher, AccuWeather includes software that lets you monitor weather conditions from the computer as well as log data to disk. One nice thing about the software is that you see all the weather readings at once on-screen, rather than seeing only one reading at a time on the control unit's LCD. A serial port on the AccuWeather control unit connects to a serial port on the PC. The software defaults to COM1, but it's easy to change the port setting if it becomes necessary.

It seems that the weather forecast is always wrong these days. But with the power of AccuWeather at your fingertips, perhaps you can make better predictions on your own.

For more information on the RadioShack AccuWeather Weather Station, see your local RadioShack store, contact RadioShack (One Tandy Center, Ft. Worth, TX 76102) directly, or circle 15 on the Free Information Card. **EN**

### NEW LITERATURE

*continued from page 5*

switching techniques; transmission/propagation concerns; video technology; and more. Released by the General Services Administration (GSA), use of this glossary by is mandatory: "all federal departments and agencies shall use (this reference) as the authoritative source of definitions for terms used in preparation of all telecommunications documentation."

This official glossary is designated standard FED-STD-1037-C, superseding the 1991 version. It was developed by the Federal Telecommunications Standards Committee and issued by the GSA in order to improve the federal-acquisition process by providing Federal

departments and agencies with an authoritative and complete source of definitions that are used by national, international, and U.S. Government telecommunications specialists.

The CD-ROM contains two versions of the Glossary: an Adobe Acrobat version along with the Adobe free reader software, and a complete HTML Web site version of the glossary. Simply point your Web browser at the files on the CD to navigate through the Glossary. It will run under Windows, Windows95, Windows NT, Mac OS, and UNIX systems. LAN licenses are available for corporations wishing to put the Glossary on an internal network.

### Digital Consumer Electronics Handbook

*McGraw-Hill, Inc.*

*11 West 19th Street*

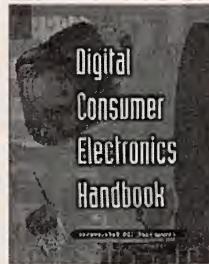
*New York, NY 10011*

*Tel: 212-337-5951*

*Fax: 212-337-4092*

*Web: www.ee.mcgraw-hill.com*

**\$9.50**



**CIRCLE 346 ON FREE INFORMATION CARD**

This title is an essential reference tool enabling readers to understand even the most complex digital technologies in today's fast-changing world of digital consumer electronics. A wealth of engineering information is presented as the handbook takes you step by step through the technologies for optical video systems; digital versatile disk (DVD); high-definition television (HDTV); digital VCRs, camcorders, and photography; digital cable systems; CD players; PCs; and more.

Readers will find complete details on fundamental digital concepts and on enabling technologies; the latest standards; delivery and reception systems; imaging, audio, and information and

communication products; appliances; residential automation; and more. Each section is edited by experts in their particular field, and there are over 650 helpful illustrations packed into this volume.

### 1997/1998 Instrumentation Catalog

*Fluke Corporation*

*P.O. Box 9090*

*Everett, WA 98206*

*Tel: 800-44FLUKE or 425-356-6600*

*Fax: 800-FLUKE-FAX or 425-356-5116*

*E-mail: fluke-info@tc.fluke.com*

*Web: www.fluke.com/nettools*

**Free**



**CIRCLE 347 ON FREE INFORMATION CARD**

Fluke Corporation's 240-page catalog presents the full range of their instruments, accessories, and software for test and measurement, calibration, data acquisition, network testing, and many other application areas. The selection of products represented here is broader than ever, enabling users to choose the right tools for virtually every job. Professionals rely on Fluke's test tools to provide fast, top-quality information, as they are known to be rugged, accurate, and intuitively easy to operate.

Since a variety of new products were recently introduced and improvements were made to several others, a brief overview of the latest and most popular products is featured in the full-color Product Highlights section. Some of the products included there are the 5720A Calibrator; the 160 Series Multifunction Counter; and the CombiScope B, a combined digital-storage and analog oscilloscope. The remainder of the catalog is sub-divided into application-related categories, making it easy to find exactly what you need in the shortest possible time.

It is a user-friendly catalog with section headings at the top of each page. Almost all sections begin with a selection guide to let you easily compare key features and specifications. Details on calibration documentation and power cord options are in a section entitled "Working with Fluke."

### Books Now

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (702) 258-3338 ask for ext. 1456 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>



# LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

## Oscillophones: "Son of the Tonal Voltmeter"

A method exists to probe breadboarded circuits (both analog and digital) without needing to look at a display or using a logic probe that measures more than ones and zeros. Oscillophones, the offspring of my "Tonal Voltmeter" (*Electronics Now*, September 1996), functions like a logic probe, a multimeter, and an oscilloscope; but it doesn't depend on an analog, digital, bargraph, or line-chart display.

Oscillophones converts the probe input into a balanced tone that is heard through headphones. This instrument makes troubleshooting easier. The schematic, which represents a simple, stand-alone device, is on the Web: <http://home.att.net/~Lshaping>. By adding just a little more than two diodes (a slight exaggeration) to the original tonal voltmeter, oscillophones was born. I thought your readers might like to take a look at this unit.

MARK O. BENDER  
via e-mail

## F.Y.I.

I've recently done tests on "stray" capacitance, which may be useful to your readers. Those who enjoy designing and breadboarding their own designs can relate to this problem.

In a high-speed analog circuit I designed, my breadboard layout exhibited the usual stray capacitance effects at high sweep rates on my oscilloscope display. After talking to an engineer, I began

Write To:  
Letters,  
Electronics Now Magazine,  
500 Bi-County Blvd.,  
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

to suspect the "innocent" solderless breadboard itself. Sure enough, after making a direct capacitance measurement of adjacent terminal rows on the board, I found about 3 pF between each row of adjacent pin terminals! This indeed can play havoc with high-speed, fast rise-time circuitry.

My next question was "So how does a DIP socket affect circuit operation?" Measuring this capacitance was a bit more difficult; however, I came up with a method of hooking up alternate rows of DIP socket pins on a ZIF socket. This allowed me to measure the total capacitance of a series of standard DIP sockets by inserting them into the ZIF socket and taking the difference of the "fixture" capacitance with and without the socket-

under-test. By dividing this result by the effective number of capacitors thus formed, I found the following results (average) between each pair of pins:

Standard, low-profile, solder-tail sockets measured about 0.25 pF between pins. The double-leaf variety also measured about 0.30 pF between pins. Not a lot to worry about, except in RF designs!

My conclusions: If your circuit works fairly well on a breadboard, it should improve on a socketed printed-circuit board. If you're experimenting with expensive chips, use DIP sockets—they can always be removed later, if necessary! If you're designing high-frequency RF circuits, avoid sockets and breadboards!

SKIP CAMPISI

S. Bound Brook, NJ

EN

## One Touch Auto Set-Up

100MHz and  
200MHz Analog  
Oscilloscopes

±2% Accuracy

Save & Recall  
Up To 32  
Panel Settings



3 Year Product Warranty

Model SS-7821, 200 MHz Bandwidth - \$2,995.

Model SS-7811, 100 MHz Bandwidth - \$1,795.

Featuring... 3-CH, 8 Traces • 2m V/div Sensitivity • Full TV Trigger with Field and Line Select

- 5 Digit Frequency Counter • Cursor Measurements with CRT Readouts • Fine Adjustment Modes
- Auto Probe Readout, CH-2 Output • Z-Axis Input • Bright, Sharp, 6" Meshless CRT • Built-in Diagnostics.

Also available: 400 MHz & 470 MHz models. Send for Complete Catalog

**IWATSU AMERICA, Inc.**

TEST & MEASUREMENT EQUIPMENT DIVISION

430 Commerce Blvd., Carlstadt, NJ 07072 • Tel: (201) 935-8486 • Fax: (201) 935-8533

WebSite: <http://www.iwatsu.com> • e-mail: [iwatsu@access.digex.net](mailto:iwatsu@access.digex.net)

CIRCLE 134 ON FREE INFORMATION CARD

# Pilot Graphing, Small C, E-mail, and More

**W**E'VE GOT THREE THINGS TO TALK ABOUT THIS TIME: CORRECTIONS TO LAST MONTH'S COLUMN, THE NEXT PART IN OUR SERIES ON PALMPILOT SERIAL I/O, AND A LONG-OVERDUE READER E-MAIL CATCH-UP.

## Corrections

Last month I mentioned the PilotMain routine, which is the main processing loop of any Pilot application. Conceptually, it more or less corresponds with the main routine in a generic C program. A better analogy might be WinMain in a Windows program. In any case, I neglected to include the code for that routine. It's shown here as Listing 1. The code shown last time should have been tagged Listing 2, and all references to SerIOReceive should have referenced Listing 2. Sorry for the confusion.

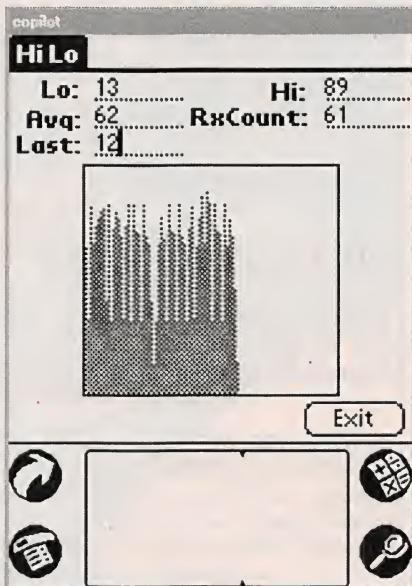
Second, I stated that CoPilot, a free-ware Win32-hosted Pilot emulator, can't do serial I/O. Whoops, it can. I must have had a configuration problem. In any case, I decided to give it one more try while developing the code for this month's installment and got it to work.

Third, I stated that the Pilot OS is not multitasking. Further research has proved that statement incorrect. The PalmPilot SDK documentation gives an extremely brief discussion of how the HotSync application works. Basically, there are two threads. One tends to serial I/O; the other tends to the user interface. There is no example showing how this works, however. Nonetheless, because of performance problems uncovered this time, it may be worth experimenting with

## HiLo Version 2

You'll recall from last time that we started developing an application called

HiLo. HiLo accepts byte-sized inputs from the serial port and tracks the minimum, maximum, average value, and count of values received. The new version adds a little graphics to the mix, as shown in Fig. 1. The chart occupying the central portion of the screen is the primary addition. My original plan was to implement a scrolling chart-recorder type of display. The current version is really just a graph that displays a maximum of 100 points from left to right. I still call it a chart recorder because that is the goal.



THIS MONTH'S INSTALLMENT of our Pilot programming series shows how to graph incoming data on the screen of our HiLo app.

This month's Listing 2 contains the differences between this and last month's code. Mostly there are additions. There is a new section of #defines, three new global variables, and two new functions. One function creates the chart recorder; the other displays new data points as they arrive.

The Pilot's screen measures 160 by 160 pixels. I thought a 100 by 100 chart would be nice and would simplify scaling. However, there wasn't enough space vertically in the current user interface, so I trimmed the chart to a height of 90 pixels. The size and location of the chart and the scale factor are determined by the #defines.

The new functions have been integrated as follows. PilotMain calls a routine named StartApplication. It in turn calls our new CreateChartRec function. CreateChartRec doesn't actually create any new user-interface objects. It simply displays on the current window a rectangle surrounding the space that will be used to plot points.

The other new routine is called AddPoint. It is called at the end of the primary I/O routine, SerIOReceive. What AddPoint does is add the current value to a global array called Data. The program then scales that value and displays it. If a value exceeds the height of the display area, it is truncated to the height. The routine also displays the numeric representation of the scaled value in the "Last Received" field.

The routine that plots the value is an OS call named WinDrawGrayLine that takes four parameters that refer to the start and end points of the line: x1, y1, x2, and y2. The routine doesn't actually draw a gray line; the PalmOS supports only 1-bit (monochrome) graphics. Instead it skips every other pixel.

## Evaluation

The bad thing about this version of the program is that it is sloooooooow. It can't even keep up with 9600bps communications. If you send several values in quick succession, values are not lost, but screen drawing continues long after the last value has been sent.

There are several opportunities for optimization. The primary one is that we are retrieving characters one at a time from the serial receive buffer. Obviously, we could improve performance by getting several characters at once. But will that be enough to make screen-draw performance acceptable? We'll take that up next time. And while we're at it, let's see if we can make this thing work like a real (scrolling) chart recorder.

Incidentally, I use a handy little free-ware utility called SimpleTerm to drive the CoPilot emulator. SimpleTerm allows you to send and receive data on the Pilot, just like ProComm, HyperTerminal, or similar programs. In that configuration, the Pilot remains in its cradle, which is attached to COM1 on my development machine. I developed the HiLo code in CodeWarrior, and when it compiles, load it into CoPilot. CoPilot is likewise configured to use COM1. For testing on the Pilot itself, I simply download HiLo.PRC to the Pilot using the InstApp utility that comes with every Pilot. Then, on the PC, I make sure HotSync is closed down (otherwise there will be port contention) and run HyperTerminal to drive the Pilot. The process is awkward, but doesn't require any cable swapping or extra ports. A cleaner solution would be an extra port connected to the pilot via a modem cable.

Also, I've developed a Windows-hosted shareware program that helps you organize and install files on your Pilot. The chief value of the program is that it lets you create sets of programs that may be installed as a group. Thus you might have one set for everyday use, another

## LISTING 1—PilotMain

```
DWord PilotMain(Word cmd, Ptr cmdPBP,
Word launchFlags) {
    if (cmd ==
        sysAppLaunchCmdNormalLaunch) {
            StartApplication();
            EventLoop();
            StopApplication();
        }
    return 0;
}
```

## LISTING 2—UPDATES FOR HILO

```
...
/* defines */
#define ChartRectLeft 30
#define ChartRectTop 52
#define ChartRectWidth 100
#define ChartRectHeight 90
#define MaxDataPoints ChartRectWidth
#define VertScale ChartRectHeight / 100
...
...
/* global variables */
...
static RectangleType ChartRecRect;
static Short Data[ChartRectWidth];
static Short DataPoints = 0;
...
...
/* Function prototypes */
...
static void CreateChartRec(void);
static void AddPoint (Short pt);
...
static void SerIOReceive(void) {
    ...
    ShowNumResultFld (HiLoMainFldLastField, SerIOCur);
    AddPoint (SerIOCur);
}
...
static void CreateChartRecRect(void) {
    ChartRecRect.topLeft.x = ChartRectLeft;
    ChartRecRect.topLeft.y = ChartRectTop;
    ChartRecRect.extent.x = ChartRectWidth;
    ChartRecRect.extent.y = ChartRectHeight;
    WinDrawRectangleFrame(simpleFrame, &ChartRecRect);
}
...
...
static void AddPoint (Short pt) {
    Short LineHt;
    if (DataPoints < MaxDataPoints) {
        Data[DataPoints] = pt;
        LineHt = (int) (pt * VertScale + 1);
        LineHt = (LineHt > ChartRectHeight) ? ChartRectHeight : LineHt;
        ShowNumResultFld (HiLoMainFldLastField, LineHt);
        WinDrawGrayLine(ChartRectLeft + DataPoints,
                        ChartRectTop + ChartRectHeight - 1,
                        ChartRectLeft + DataPoints,
                        ChartRectTop + ChartRectHeight - LineHt);
        DataPoints++;
    }
}
```

for development, *etc.* Check the Pilot section of my new Web site, [www.ingenic.com](http://www.ingenic.com) for details and a free evaluation copy. I'll also be posting code and other information from previous and future columns.

## E-mail

It seems that lots of people have an interest in small C compilers (discussed in the November column). Todd Sepke wrote to plug GCC running on Linux.

(Continued on page 22)

# Troubleshooting and Repairing CD Players and CD-ROM Drives



VER THE NEXT FEW MONTHS WE ARE GOING TO LOOK INTO ALL THE CD AUDIO AND CD-ROM PLAYERS THAT ABOUND AROUND US. WE'LL BEGIN WITH A LOOK AT THE

BASICS OF HOW THESE DEVICES WORK. THEN WE WILL MOVE ON TO

maintenance, repair (including whether or not one of these units is worth repairing), disk care and repair, and more. We will conclude the series with some notes about specific equipment repairs.

Most of the information that we'll be presenting applies to CD players in component stereo systems, compact stereos, boom boxes, car units, and portables, as well as CD-ROM drives. The primary differences between those relate to how the disc is loaded; for example, portables are usually top loaders without a loading drawer. The one thing that is true regardless of the type of unit is that everything is tiny; and most or all of the electrical components are surface mounted on both sides of an often inaccessible printed-circuit board, with the entire unit assembled using screws that have minds of their own and a desire to be lost.

Note that Laserdisc players and optical-disk storage units have much in common with CD players. They tend to use similar mechanical components and front-end electronics. Therefore, this column will also help you get started troubleshooting these items as well.

## Things That Go Wrong

Many common problems with CD players can be corrected without the service manual or the use of sophisticated test equipment. CD-player problems break down into specific groups:

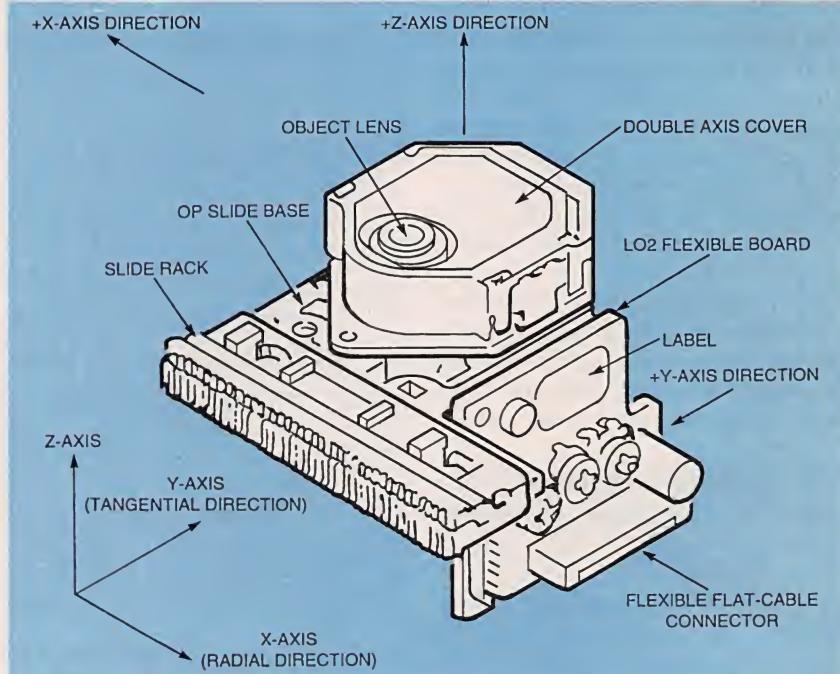
- **Mechanical:** Problems here include

dirt, lubrication, wear, deteriorated rubber parts, dirty/bad limit switches, and physical damage. A dirty lens—easily remedied—is probably the number one cause of common problems such as discs not being recognized, audible noise, and erratic tracking. Even professionals may be led to believe that those symptoms are being caused by much more serious (and expensive) faults. Don't be fooled!

• **Electronic Adjustments:** These include coarse tracking, fine tracking, focus, and laser power. Note that some newer CD players no longer have all of these adjustments.

• **Electronic Component Failure:** These are rare except for power-surge (storm and lightning strike) related damage, which, if you are lucky, will only blow out components in the power supply.

You can often repair a CD player that has a mechanical- or electronic-adjustment problem. The only real exception is a problem in the laser power supply, which I would not attempt to repair without a service manual and/or proper instrumentation, except as a last resort; im-



A CD PLAYER'S OPTICAL PICKUP must position the focal point of the laser beam to an accuracy of around 1  $\mu\text{m}$  (micron or .000001 meter) and features complex electronic and mechanical components; yet the most common "repair" you'll need to do is to clean a dirty lens.

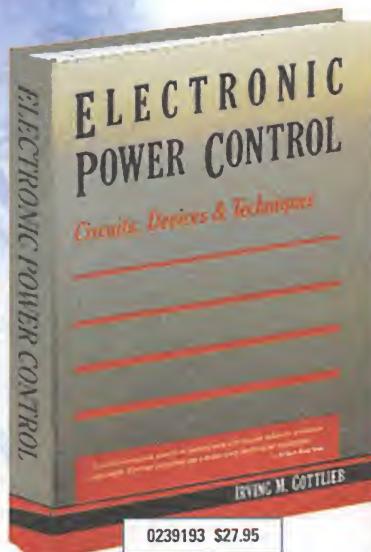
# Quickly And Easily Troubleshoot Any Kind Of Electronics Problem...

Choose

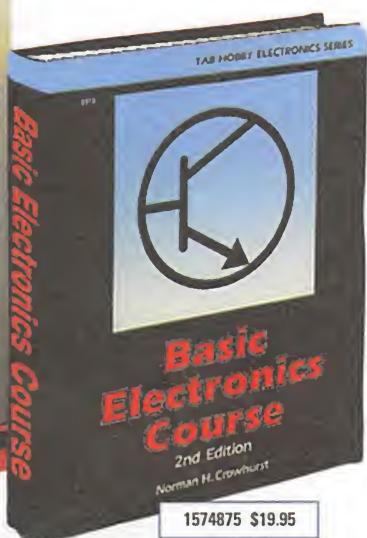
**5 Books  
FOR ONLY  
\$495**

**VALUES TO  
\$258.90**

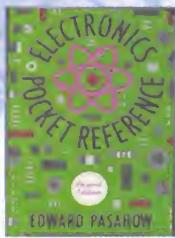
When you  
join the  
Electronics  
Book Club®



0239193 \$27.95



1574875 \$19.95



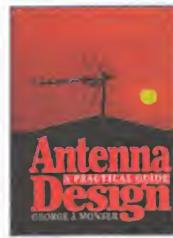
0487375 \$24.95



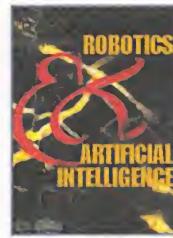
0497060 \$34.95



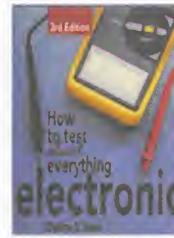
0242054 \$24.95



0428433-XX \$60.00  
Counts as 2



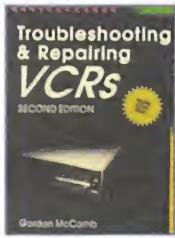
0236143 \$24.95



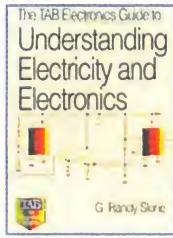
0304068 \$17.95



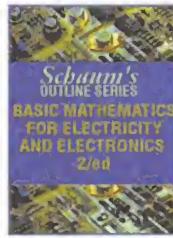
0707618 \$21.95



1550178 \$22.95



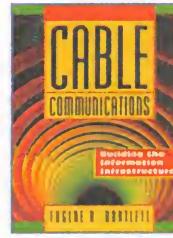
0582165 \$19.95



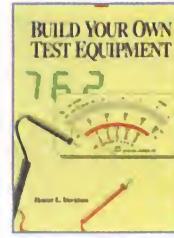
0044392 \$14.95



0350787-XX \$44.95  
Counts as 2



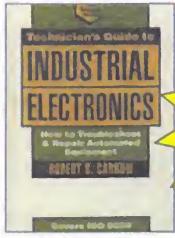
0053553 \$50.00



0155593 \$22.95



1577564 \$24.95



0112738 \$47.95  
Hardcover



0717753 \$19.95



**Electronics  
Book Club®**

**Your One-Stop  
Electronics Resource!**

*A Division of The McGraw-Hill Companies, PO Box 549, Blacklick, OH 43004-0549*

**YES!** Please send me the books listed below, billing me just \$4.95, plus shipping/handling & tax. Enroll me as a member of the **Electronics Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books without obligation and have my membership cancelled. I agree to purchase just 2 more selections at regular Club prices during the next 12 months and may resign anytime thereafter.

Code #'s of my book(s) for \$4.95

--	--	--	--	--

If a book counts as two, write the book number in one box and XX in the next.

Name \_\_\_\_\_



Signature \_\_\_\_\_ (Required on all orders)

Address/Apt. # \_\_\_\_\_

City/State \_\_\_\_\_ Zip \_\_\_\_\_ Phone \_\_\_\_\_

Valid for new members only, subject to acceptance by EBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

**See other side  
for more great  
selections...**

# Choose

**5 Books  
FOR ONLY**

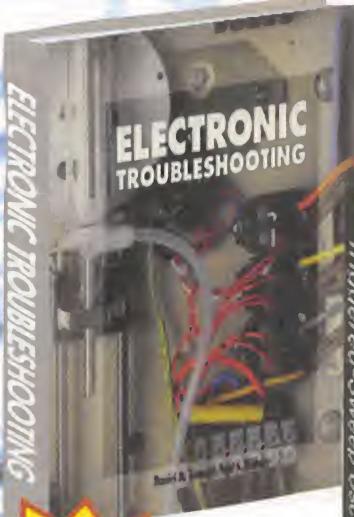
**\$4.95**

*When you join the*

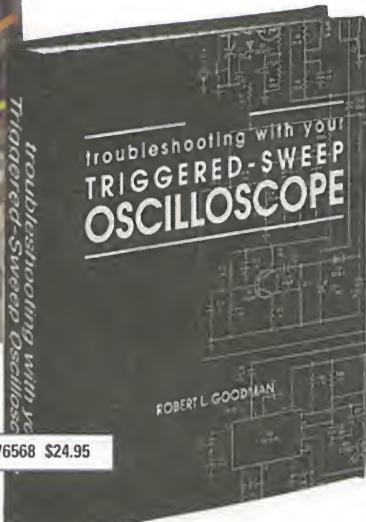
**Electronics  
Book Club®**



0717753 \$19.95

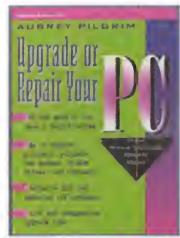


0650780 \$27.95

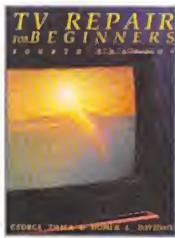


1576568 \$24.95

**VALUES TO  
\$258.90**



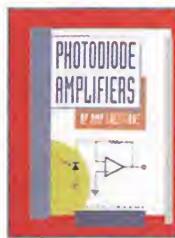
0501149 \$26.95



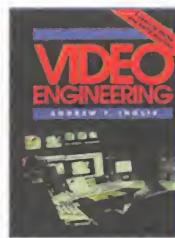
073092X \$21.95



0241996 \$44.95



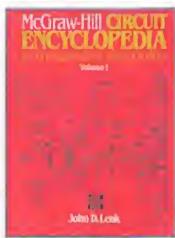
024247X \$49.00



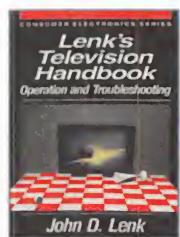
0317917 \$60.00



0331898-XX \$89.50  
Counts as 2



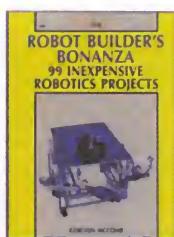
0380767 \$39.95



0375178-XX \$44.95  
Counts as 2



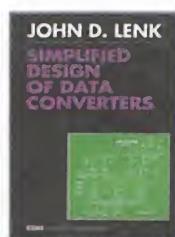
0535469 \$29.95



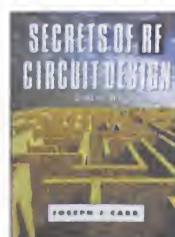
1571469 \$18.95



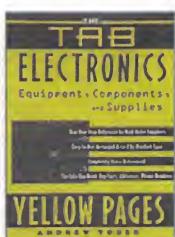
0304084 \$26.95



587735X \$29.95



0116725 \$49.95



076512X \$49.95



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES



**BUSINESS REPLY MAIL**

FIRST CLASS MAIL PERMIT NO. 4474 COLUMBUS OH

POSTAGE WILL BE PAID BY ADDRESSEE

**ELECTRONICS BOOK CLUB®**

*A Division of The McGraw-Hill Companies*

PO BOX 182600  
COLUMBUS OH 43272-3027



As a member of the  
**ELECTRONICS BOOK CLUB...**

you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main Selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 2 more books during the next 12 months, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program. A shipping/handling charge and sales tax will be added to all orders. All books are paperback unless otherwise noted. Publishers' Prices Shown © 1997 EBC

If card is missing, write to:  
**Electronics Book Club®**,  
*A Division of The McGraw-Hill Companies, P.O. Box 549,  
Blacklick, OH 43004-0549*  
**PHONE:** 1-614-759-3666  
(8:30 a.m. to 5:00 p.m. EST Monday-Friday)  
**FAX:** 1-614-759-3749  
(24 hours a day, 7 days a week)

**E-MAIL:** [bookclubs@mcgraw-hill.com](mailto:bookclubs@mcgraw-hill.com)  
**INTERNET:** [www.bookclubs.mcgraw-hill.com](http://www.bookclubs.mcgraw-hill.com)

proper adjustment of the supply can ruin the laser. Note that if the player recognizes discs, or even if the unit only focuses correctly, then the laser diode and its power supply are probably fine. While laser diodes can and do fail, don't assume that every CD player problem is laser-related. In fact, only a small percentage (probably under 10%) are due to a failure of the laser diode or its supporting circuitry. Mechanical problems such as dirt and lubrication are the most common faults. Electronic (servo) adjustments come second.

Component failures in the power supply can be repaired fairly easily, but most other electronic failures are difficult to locate without the service manual, test equipment, and a detailed understanding and familiarity with audio CD technology. However, you might get lucky.

### Repair or Replace?

While CD players with new, additional, and better convenience features are constantly introduced, the basic function of playing a CD has not changed significantly in the past 15 years. None of the advancements—including digital filters, oversampling, one-bit D/As, and such—are likely to make any difference in the listening pleasure of most mortals. Most people who care do so only because they are more concerned with the technology than the musical experience. Many of these so-called advances were done, at least in part, to reduce costs—not necessarily to improve performance.

So, unless you really do need a 250-disc CD changer with a remote control that has more buttons than a Boeing 777 cockpit and 2000-track programmability, a 10-year-old CD player will sound just about as good as a new unit and therefore might be worth repairing. Also, note that many older CD players were built more solidly than more recent models; even some of the new high-end CD players may be built around a mostly plastic optical deck and a flimsy chassis.

If you need to send or take the CD player or CD-ROM drive to a service center, the repair could easily exceed the cost of a new unit. Service centers charge up to \$50 or more for providing an initial estimate of repair costs, but that is normally credited toward the total cost of the repair. It does take time to find problems, and a professional technician's time is costly these days.

If you can manage to do the repairs yourself, the equation changes dramati-

cally. Your parts costs will be lower than what a professional will charge and, of course, your time is free. The educational aspects might also be appealing—you will learn a lot in the process. So it might make good sense to tackle that busted CD player in that bedraggled old boom box after all.

### CD Technology

Information on a compact disc is encoded in minute pits that reside just under the label side of the CD. The CD itself is stamped in much the same way as an old style LP, but under much more stringent clean-room conditions. The CD pressing is then aluminum-coated in a vacuum chamber, and the label side is spin-coated with a protective plastic resin and printed with the label.

CD-Rs—recordable CDs—are slightly different. CD-R blanks are pre-stamped with a spiral guide groove and then coated with an organic dye layer followed by a gold film, resin, and label. The dye layer appears greenish and deforms upon exposure to the focused writing laser beam to form pits and lands..

The newest variation—DVDs (Digital Versatile Disks or Digital Video Disks, depending on whom you listen to)—implement a number of incremental but very significant improvements in technology that add up to a spectacular increase in information density—almost 10:1 for the same size disc. Those improvements include a higher-frequency laser, closer track spacing, better encoding, and a double-sided disc. According to early reports on the final specifications, DVDs are able to store 8 times the audio of current CDs at a higher sampling rate and bit resolution, 2 hours of MPEG-encoded high quality movies, and all kinds of other information. Raw data capacity is somewhere between 5 and 10 gigabytes.

From here we are going to move on to maintenance and repair, but for those readers who would like an on-line introduction to CD and optical-disc technology, check out the [www.philipsmagnavox.com/product/pe33.html](http://www.philipsmagnavox.com/product/pe33.html) (Philips/Magnavox Electronics Reference) Web site. There you will find links to a number of articles on the basic principles of operation of CD players, Laserdisks, optical drives, TVs, VCRs, cassette decks, loudspeakers, amplifiers, satellite receivers, and other consumer A/V equipment.

If you go to [www.umn.edu/nlhome/g496/eric0l39/Papers/paper.html](http://www.umn.edu/nlhome/g496/eric0l39/Papers/paper.html) (A Fundamental Introduction to the Compact

Disc Player), you will find a somewhat more theoretical discussion of compact-disc audio technology with diagrams and even some equations.

### Preventive Maintenance

Taking good care of a CD player is not difficult. There are four simple considerations. First, try to keep the player in a cool location. While CD players do not produce any significant amounts of heat, keeping them cool will minimize wear and tear on the internal components and assure a long, trouble-free life. Second, keep CD players out of dusty locations and avoid areas with high levels of tobacco smoke or cooking-grease vapors. I cannot force you to stop smoking, but it is amazing how difficult it is to remove the brown grime deposited by smoking on sensitive electronic equipment. Third, make sure that all audio cables are connected firmly and are tight and secure. That will go a long way toward minimizing intermittent or noisy sound. Finally, store all of your CDs away from heat. The polycarbonate plastic that they are made from is quite sturdy, but high temperatures will eventually take their toll. Always return them to their cases when they are not being played.

No doubt, you have heard that a CD player should be cleaned and checked periodically. For the most part, that is nonsense. CD players, despite the astonishing precision of the optical pickup, are remarkably robust. Optical alignment is almost never needed for a component CD player and is rarely required even for portable or automotive units.

An occasional internal inspection and cleaning is not a bad idea, but it is not nearly as important as for a VCR. Realistically, then, you are unlikely to do any preventive maintenance; so let me just point out the types of symptoms that indicate the need for a cleaning or other preventive or corrective maintenance. Those include problems like erratic loading, a need to convince the CD player to cooperate and play a disc, audio noise, skipping, sticking, or taking longer than usual to recognize a disc or complete a search. Of course, acute symptoms, like refusing to play or to open the door, are definite signs that immediate emergency treatment is needed.

Generally, I do not consider CD-lens cleaning discs to be of much value for preventive maintenance, since all too often they only move the crud around. However, for non-greasy dust, they

might do a good enough job for a proper cleaning to be put off for a while longer.

Although CDs are much more tolerant of abuse than LPs, some precautions are still needed to assure long life. Also, even though only one side is played, serious damage to either side can cause problems during play or even make the CD totally useless. It is important to protect the label side from major scratches that could penetrate to the information layer. Even with the sophisticated error-correction systems used, damage to this layer, particularly if it runs parallel to the tracks, can make the CD unusable.

Remember, the CD is read by focusing a laser beam through the bottom 1.2 mm of polycarbonate. As a result of the design of the optical system used in the laser pickup, the beam diameter is about 1 mm at the bottom surface, and thus small surface scratches appear out of focus and in many cases are ignored. At the information layer, however, the beam diameter has been reduced (by precise focusing) to under 2  $\mu$ m. Here, scratches running parallel to the tracks can cause the optical pickup to get "stuck," repeating a track, jumping forward or back a few seconds, or creating noise or other problems.

That's all for now. Until next time, if you have any specific problems or questions, contact me directly at sam@stdavids.picker.com. For general information on electronics troubleshooting and repair, you can visit my Web site at [www.repairfaq.org](http://www.repairfaq.org).

EN

# POPTRONIX®

Online  
Edition

We're on the web **FREE**

<http://www.poptronix.com>

**WE'RE WITH YOU EVERY DAY  
24 HOURS A DAY! DROP IN!  
WE'D LOVE TO HAVE YOU VISIT!**

EXERCISE.

American Heart  
Association



## COMPUTER CONNECTIONS

continued from page 17

### SMALL C COMPILERS

Mix Power C: [www.mixsoftware.com](http://www.mixsoftware.com)  
Micro-C/PC: [www.dunfield.com/downld.html](http://www.dunfield.com/downld.html)  
Pacific C: [www.hitech.com.au/pacific.html](http://www.hitech.com.au/pacific.html)  
Dr. Dobb's Small-C Resource CD-ROM:  
[www.ddj.com/cdrom](http://www.ddj.com/cdrom)  
Cmm: [www.nombas.com](http://www.nombas.com)

### Pilot Developer Resources

[www.ingeninc.com](http://www.ingeninc.com)  
[www.wademan.com/Pilot/Program/FAQ.htm](http://www.wademan.com/Pilot/Program/FAQ.htm)  
[www.massena.com/darrin/pilot/index.html](http://www.massena.com/darrin/pilot/index.html)  
[www.sls.lcs.mit.edu/raylau/pilot/](http://www.sls.lcs.mit.edu/raylau/pilot/)  
[www.usr.com/palm/pilotlinks.html](http://www.usr.com/palm/pilotlinks.html)  
[www.roadcoders.com/pilot/index.html](http://www.roadcoders.com/pilot/index.html)  
[www.shoppersmart.com/jlehett/gccwin32.html](http://www.shoppersmart.com/jlehett/gccwin32.html)  
[www.usr.com/palm/dresources.html](http://www.usr.com/palm/dresources.html)  
[www.metrowerks.com](http://www.metrowerks.com) (general info)  
[www.metrowerks.com/db/updates.qry?function=list&sw=CWPP3](http://www.metrowerks.com/db/updates.qry?function=list&sw=CWPP3) (patches)

### Newsgroups:

[alt.comp.sys.palmtops.pilot](http://alt.comp.sys.palmtops.pilot)  
[comp.sys.palmtops.pilot](http://comp.sys.palmtops.pilot)  
[news.massena.com/pilot.programmer](http://news.massena.com/pilot.programmer)  
[news.massena.com/pilot.programmer.codewarrior](http://news.massena.com/pilot.programmer.codewarrior)  
[news.massena.com/pilot.programmer.gcc](http://news.massena.com/pilot.programmer.gcc)  
[news.massena.com/pilot.programmer.jump](http://news.massena.com/pilot.programmer.jump)  
[news.massena.com/pilot.programmer.pila](http://news.massena.com/pilot.programmer.pila)

Regarding compilers *per se*, numerous people wrote to suggest various alternatives. One of the most popular is Mix Power C, suggested by several people, including Jim Goodman. Jim also recommended Pacific C and Micro-C/PC. Pacific C is available free for noncommercial use. Micro-C/PC is a targetable C compiler that generates code for several microprocessors and microcontrollers.

For learning purposes, I would recommend checking out *Dr. Dobb's Small-C Resource CD-ROM*, published by *Dr. Dobb's Journal*, one of the oldest PC-oriented programming magazines. I haven't seen the CD-ROM, but I have an old version of Small C on my system; it includes complete source code for the compiler and libraries. Alas, the version I have doesn't do pointers, but more recent versions might. Another interesting alternative is Cmm, (C-minus-minus) a sort of scripting environment heavily influenced by C, but without the hard stuff (pointers and memory management). EN

## NEW PRODUCTS

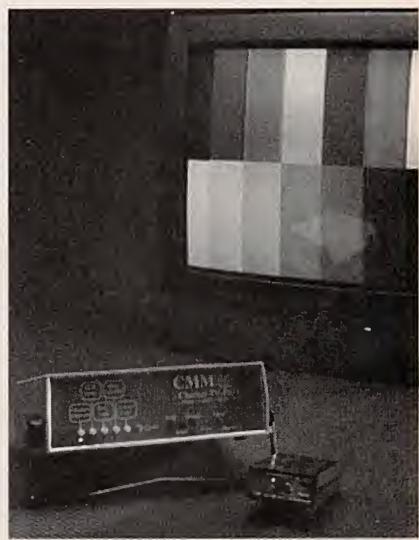
continued from page 3

### AEMC Instruments

99 Chauncy Street  
Boston, MA 02111  
Tel: 800-343-1391 or 617-451-0227  
Fax: 617-423-2952

### TV Test-Pattern Generator

Checker TV PRO and Checker TV Jr. are suitable for both test bench or field operation. Among TV PRO features are split-field color bars, gray scale, S-video output, RF output, and one-volt video. A stereo processor and tone generator allows the stereo detection and audio portions of the receiver to be tested. Patterns include a cross hatch with dots and white screen. Red, green, and blue signals are push-button selectable, as is the stereo signal and the audio tone. The unit can be AC or battery operated.



CIRCLE 22 ON FREE INFORMATION CARD

Small enough to fit into your hand (1x2x3-inches), the TV Jr. is convenient for field use, fitting easily into the technician's pocket or toolbox. The Jr. has color-bars; white, red, blue, green, and black screens; and cross hatch with dots. The various patterns are selectable by a single push button. Operating on a 9-volt battery, its output is 1-volt RS-170 NTSC color video.

Both generators are NTSC, RS-170 video compatible, and have complex synchronization. The suggested retail prices are \$599.99 for the Checker TV PRO and \$149.99 for the Checker TV Jr.

(Continued on page 28)

# Proto

# type

## Microflyers: The Ultimate in Unmanned Aircraft

**T**he explosion had rendered the building extremely dangerous. Rescuers need more information on the condition of the building before they dare enter to search for survivors. To do this they release a dozen palm-sized "aircraft" that fly into the ruined building. Flying autonomously, they swarm through the building sending back pictures from their tiny video cameras.

to enemy troops. Potential civilian applications include killing harmful insects, flying down smokestacks to measure emissions, monitoring chemical and oil spills, searching for survivors in damaged buildings, or tracking wild animal herds.

Some researchers are working on rather conventional fixed-wing designs, if you can call a four-ounce, six-inch long

His "entomopter," a name chosen because of his design's insect-like characteristics, uses reciprocating chemical muscle (RCM) for motion. Not only could the entomopter fly, it could also crawl and maybe even swim. With RCM, a monopropellant fuel is used to produce a reciprocating motion such as beating wings or scurrying feet. Additionally, RCM can generate electricity needed for the microflyer's controls and to power on-board electronic equipment. Gas generated as a byproduct of RCM can be used to change the lift on either wing to allow the otherwise-autonomous, symmetric wing beating to produce "rolling" so the entomopter can turn right or left.

Though flown under human control, microflyers will have to fly autonomously to avoid obstacles and maintain stable flight on their own. The smaller an aircraft gets, the more skittish it acts. Human operators often cannot react in time to control a tiny aircraft, especially when viewing the scene from an on-board camera on a TV monitor.

"Flying a remote-controlled helicopter is extremely difficult, and even experienced people crash them all the time," says Dr. Samuel Blankenship, coordinator for the Georgia Tech Focused Research Program for Microflyers. Furthermore, "These aircraft will need autonomy so we don't have to spend a lot of time training people to operate them." Autonomous navigation techniques under consideration include a geographic information system (GIS) for terrain-map following or use of the global positioning system (GPS).

Even though Michelson's current prototype is small, featuring a 10-inch wingspan, it has to be shrunk even further. The goal is a bird-like six inches at its largest point and a weight of a mere four ounces. Flight controls, power sources, propulsion



ROBERT MICHELSON AND HIS FLAPPING WING "ENTOMOPTER." The goal is to make it even smaller. Advances in micro electro-mechanical systems and microelectronics technology give engineers confidence they can do so. (Georgia Tech photo by Stanley Leary)

Wait a second! What's this about an airplane small enough to fit in the palm of your hand that flies like an insect or a bird? Sounds far-fetched? Well, the Defense Advanced Research Project Agency (DARPA) and the Georgia Tech Research Institute (GTRI) don't think so. They along with others are now developing tiny microflyers.

The military is interested in those tiny aircraft for missions like detecting biological and chemical agents on the battlefield, "over-the-hill" reconnaissance, or delivering a disabling "sting"

airplane conventional. Those could be powered by a micropulse jet engine, tiny jet turbine, or ducted fan engine. Whirling propellers or rotor blades are too dangerous for many of the missions planned for the microflyers. Fossil fuels would be used, at least initially, because a drop of gasoline contains more energy potential than current batteries of the same size.

### The "Entomopter"

GTRI research engineer Robert Michelson has a more radical concept.

systems, avionics, and payload are allowed a mere two ounces. Performance requirements include speeds of up to 50 mph and a range of 10 kilometers.

### On-Board Electronics

Other researchers are working on miniaturizing the microflyer's electronic payloads. For instance, they are developing ultra-small and very simple sensors to detect toxic chemical and biological agents on the battlefield. Those sensors, basically small chips of glass with optical waveguides fabricated on their surfaces,

suspected of being used or a known emission to be measured. In cases where the exact chemical is unknown, multiple sensing/reference pairs on the same optical chip can be used along with pattern-recognition techniques to determine the chemistry. A dozen channels can be put on a single chip to determine what the microflyer is flying through. Already small, about 1 cm by 2 cm, the sensors would have to be made even smaller to fit on the microflyer, and they would have to include signal-processing electronics.

Researchers also are working on miniaturized visual sensors and commu-

could serve as a stabilizer, while fuel would be stored in the legs. A self-consuming system is also being considered, where the entomopter itself would be used as fuel as it "eats on the run" to extend mission endurance.

Besides being tiny, microflyers have to be cheap since they most likely will be expendable. They could be consumed as fuel or not be recoverable because they have flown through toxic atmospheres. The goal is about a \$1000 each for military applications.—BILL SIURU **PT**

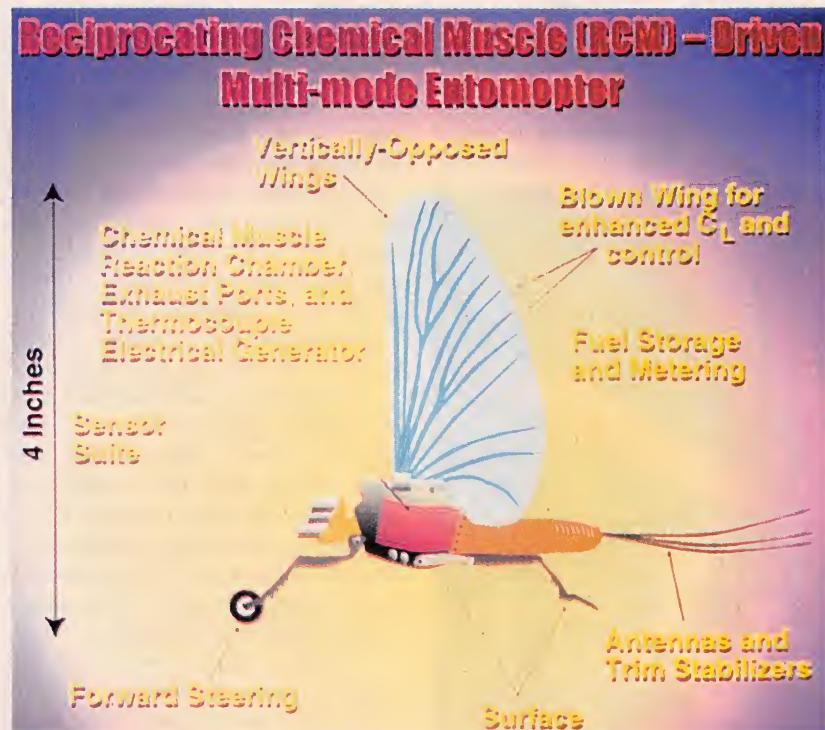
## Radar Flashlight "Sees" Through Walls

A prototype radar flashlight that can detect someone's presence through walls and doors could one day be used by the police and others to make their jobs safer. Gene Greneker, principal researcher at the Georgia Tech Research Institute (GTRI), explained that the development is part of a family of technologies that also picks up the heartbeat. The device uses a rather narrow radar beam of about 15 to 20 degrees and a specialized signal processor to locate movement, and it discerns respiration from up to three meters away.

"Based on respiration signature alone, the radar flashlight allows us to detect a stationary individual behind a solid wooden door or standing four feet behind an eight-inch block wall," said Greneker. "These qualities make the flashlight potentially useful to police officers in ambush situations and to prison guards doing bed checks."

The radar technology has some advantages over other technologies. "The signal from the radar flashlight will penetrate clothes and detect respiration through a heavy jacket," Greneker stated. "In fact, the radar flashlight requires a body movement of only a few millimeters to detect human presence."

For now, the signal processor is outside the casing, and the respiration signature is displayed on a monitor driven by a computer-based radar-signal processor. Greneker plans to eventually make everything small enough to fit inside the flashlight housing by incorpo-



THE RECIPROCATING CHEMICAL MUSCLE driven entomopter. Wind, rain, and air resistance as well as keeping weight to a minimum, represent significant challenges when the Entomopter is flown outdoors. (Georgia Tech photo by Stanley Leary)

would trap and manipulate light.

On the most basic level, the sensors would have only two channels, one for sensing and the other as a reference. When a toxic chemical or biological sample passes through the sensing channel, the change in refractive index alters the phase of the laser light. A solid-state detector array "reads" the fringe pattern created when laser light-beams from the sensing and reference channels are combined.

These simple sensors can be designed to detect a particular chemical species

communications devices. For instance, visual sensors could use miniaturized active-pixel arrays like those in the nose cones of missiles to provide real-time image processing. At least for military applications, they will probably not use cellular frequencies, which are crowded and easily jammed, but higher frequencies, which allow the use of a smaller antenna.

Speaking of smaller, microflyers require the ultimate in miniaturization and weight reduction. Every piece of the microflyer will probably have to do double or even triple duty. A radio antenna



THE RADAR FLASHLIGHT in action—detecting someone's presence through walls and doors.

rating high-speed signal-processing technology.

Research that evolved into the radar flashlight began in the mid-1980s with the patenting of a frequency-modulated radar for remotely checking vital signs of battlefield wounded before risking medic's lives. (See the article, "High-Tech Battlefield Medicine," *Electronics Now*, April 1997.) That early technology also was tested for its ability to monitor vital signs of soldiers clothed in chemical or biological warfare suits, without requiring them to risk contamination by removing the protective gear.

Possible future applications include locating people in a room during a hostage situation and finding survivors in the rubble of earthquakes or after

major disasters such as airplane crashes, bombings, or landslides.

Most recently, Greneker developed a prototype vital-signs monitor in hopes of displaying the heartbeats of archers and rifle competitors during television coverage of the 1997 Olympic Games. Such athletes are believed to sense their heartbeats and shoot between them to avoid the slight body movement—and potential shooting inaccuracy—created by each pulse. This application ascertains heartbeat signals 30 meters from the subject. The technology's potential to monitor heartbeat raises some interesting possibilities, Gene notes.

"This version of the system might be used as a biometric identification tool," he said. For example, if it could be shown

that an individual's radar heartbeat signature is stable over long periods of time and is unique, the remotely sensed heartbeat could serve as a 'fingerprint' of sorts." **PT**

## Blood Disorders Analyzed in Minutes

A revolutionary handheld device analyzes blood samples in minutes rather than the current turnaround time of hours to weeks. The Biological Microcavity Laser has been patented by scientists at Sandia National Laboratories and the National Institutes of Health (NIH). The unit is a kind of "lab-on-a-chip," using millions of tiny fingers of laser light from an area roughly the size of a postage stamp to image cells in a drop of blood placed in a small chamber.

According to investigators Paul Gourley of Sandia and his brother Dr. Mark Gourley of the NIH and the Washington Hospital Center, it's possible to take a blood sample containing millions of cells and extract information about each cell almost immediately. In just a few minutes, the laser device can find tiny changes in cell structure, such as those caused by the AIDS virus, or to detect disorders such as sickle-cell anemia. The microcavity laser is also better able to distinguish between cancerous and non-cancerous cells than Pap smear tests, which visually analyze only relatively small numbers of cervical cells. It also should permit observers to monitor unrestricted cell growth—cancer—and

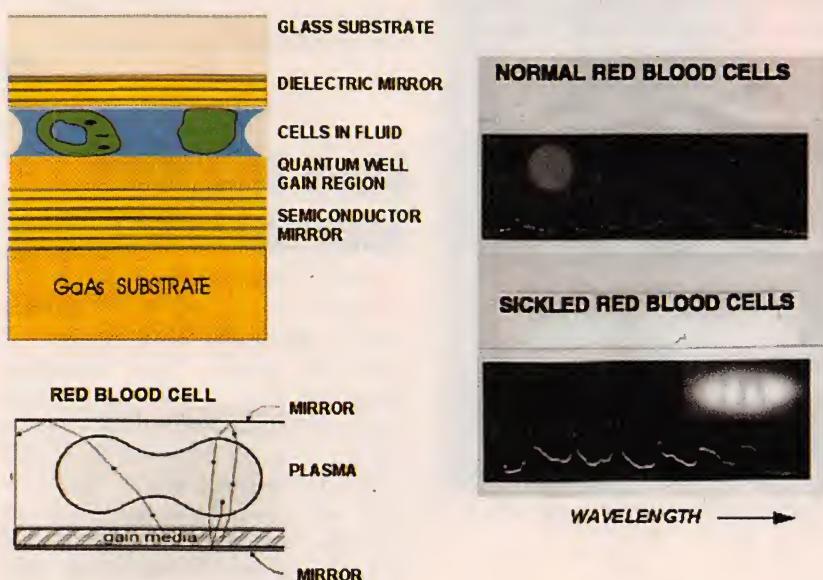
### ➤ Electronic Noise Prevents Piracy and Provides Protection

**R**esearchers at Los Alamos National Laboratory have patented a new software technique that prevents pirating of copyrighted information and unauthorized manipulation of digital images. It also allows storage and open transmission of hidden data. The "data-embedding" technique uses electronic noise, associated with images and other data, as space to store additional information without increasing the size of the host document. The "C" programming language software being used conforms to virtually any digital-storage medium.

The technique could protect intellectual property rights of digital information with unique "watermarks" that would identify illegally copied software or CD recordings. It could also embed a patient's confidential medical history in electronic X-rays or other records. Another possible use could be sending digitized military maps over open communications lines with embedded information about targets and other secret information.

Currently under development is a potential application to improve security by embedding photo identification cards with positive biometric identifiers such as iris scans or infrared thermograms of a person's face. There are additional patents pending, and the developers are seeking a commercial partner. **PT**

## BIOCAVITY LASER - A New Tool to Image Living Cells



SIDE VIEWS OF THE BIOCAVITY LASER and of a blood cell placed in the device, plus laser analysis showing what the viewer would see if the blood cells were normal or abnormal.

programmed cell death (apoptosis) as these processes take place.

Initial funding for the work came from the Department of Energy (DOE) for the purpose of developing a technology to help victims of biological or chemical attack by terrorists. Since its small size enables it to be taken anywhere easily, the time needed to analyze dangerous materials in the bloodstream of victims can be greatly reduced—minutes that could mean the difference between life or death. A portable field version using a laptop computer would cost between \$5,000 and \$15,000, Gourley estimates, and a hospital unit would cost about \$70,000.

Based on a laser device called a VCSEL—a Vertical-Cavity Surface-Emitting Laser—the concept was invented at Sandia in the mid-1980s. Blood samples are inserted into the laser itself to become part of the generation process of the VCSEL laser beams. The light reflects many times through a sample so the deviation in image created by the blood particle is magnified, greatly increasing the chances of positive, error-free identification.

"It's basically a tool to study cell structure changes," said Paul Gourley, "and it could even be used for sequencing DNA."

## Smartcard Chips

Smartcard users in 2000 will enjoy faster transaction times and greater information storage capacity as a result of a joint research and development project that was announced between Motorola's Semiconductor Products Sector and Japan's Matsushita Electronics Corp. The project will produce the next generation of chip technology for smartcards, based on FERAM (Ferroelectric Random Access Memory) rather than the EEPROM memory currently in use. The first chips are expected to be shipped by the end of 1999.

Mike Inglis, general manager, Motorola Smart Information Transfer Division, commented, "We expect to see an increasing demand for more complex applications using ever greater amounts of memory, but without an increase in transaction speed. Smartcard users won't stand at an ATM for three minutes waiting for their information to 'download.' FERAM technology will allow us to meet those demands, while maintaining the physical size and strength needed in a chip that's carried in pockets and wallets."

The challenge for smartcard chip manufacturers is to deliver chips with ever greater memory capacities to run the more complex applications, with no

loss of transaction speed. FERAM technology offers the combination of speeds 20 times faster than existing EEPROM technology with up to 10 times the memory capacity. FERAM smartcard chips could have capacities of 64K or 128K, compared to the 8K to 16K currently available.

According to Dr. Gota Kano, managing director of Matsushita Electric, "FERAM has come to the forefront of memory development, due to its remarkable properties such as endurance 10 million times more than that of FLASH and EEPROM, incredible write speeds, and its use of only a fraction of the power of any other memory technology." He added: "The winner will be the consumer, as a myriad of applications which employ this technology will provide confidence for the information society."

PT

## Solar-Energy Mission

The National Park Service is using solar power to heat, cool, and light the visitor center at the Salinas Pueblo mission, a national monument attracting 70,000 visitors a year. Located in central New Mexico, the monument consists of stone-and-adobe walls originally built by the Anasazi between 700 and 1300 AD, mixed in with the ruins of an early 17th century Spanish mission.

Sandia National Laboratories' Photovoltaic Systems Assistance Center helped integrate photovoltaics into the visitor center's existing power system. The monument's PV system should meet a large portion of its summertime energy needs and nearly all of the wintertime load. The electric grid is still connected and can provide additional power when needed. According to a Sandia spokesman, the monument is a perfect place for solar power. No one wants to see power lines overhead in a remote location.

This work is a result of the ongoing partnership between the laboratory and the Park Service, the Bureau of Land Management, the Forest Service, and the Department of Defense. It's Sandia's job to assess what these agencies have done with photovoltaic (PV) systems and the potential for future use.

PT

# Capacitance-Box Applications

**N**OW THAT YOU HAVE BUILT THE CAPACITANCE SUBSTITUTION BOX (C-BOX), YOU ARE READY TO START USING IT TO TEST ACTIVE AND PASSIVE CIRCUITS. TO GET YOU GOING, THIS MONTH I AM GOING TO PRESENT SOME EXAMPLES OF HOW

you can put the box to work.

If you do any amount of circuit designing, you will find surely find the C-Box to be a handy test-bench accessory. That's because while any designer who knows what he is doing can use standard formulas to calculate any needed values, there is nothing like a real in-circuit trial to prove the theory.

Of course, using mathematics is certainly the right way to start the design process. But once the values have been calculated, it is important to build a working prototype of the new circuit. I have been fooled in the past, when something that I calculated did not work as planned. Test and measure is always a very good idea and good advice.

To illustrate what I consider to be the proper design procedure, let's consider the circuit shown in Fig. 1. The design equations we will be using are also shown in that figure.

The first thing we will be looking at is the effect changing a capacitor will have on the audio signal. Capacitor C1 is used to set the low-frequency point in the circuit. Take a look at Equation 1. It is the design formula used to determine frequency when the resistance and capacitance are known, and it is no doubt familiar to almost anyone who has studied even a little electronics math. The problem is that the equation is not in the most convenient form for our exercise as the unknown we are looking for is the capacitance. Fortunately, that is easy enough to

fix; a little algebra allows us to rearrange the terms and gives us the formula shown in Equation 2. Since the lowest frequency of interest is 20 Hz and the impedance (resistance) is 100k, we can plug in those values to find that the capacitance needed to establish our -3-dB point is 79.57 nF.

Now let's see how this calculation works in the real world. Insert the C-Box in place of C1 and wire the rest of the circuit in the usual way. Set the C-Box to 79.57 nF. To do that, start with all of the buttons in the up position. Then depress the 4 button in the 10-nF column and then the 3 button in the same column. The next step would be to depress the 4, 3, and 2 buttons in the 1-nF column. Now push in the 4 and 1 buttons in the 100-pF column. For the final digit depress the 4 and 3 buttons in the 10-pF column. That should set the capacitance to  $79.57 \text{ nF} \pm 1\%$ .

Now, place a 20-Hz tone between C1 (the C-Box) and ground and measure the signal at the output of the first op-amp. If all is well, the output will be down 3 dB (the signal voltage will be reduced in half).

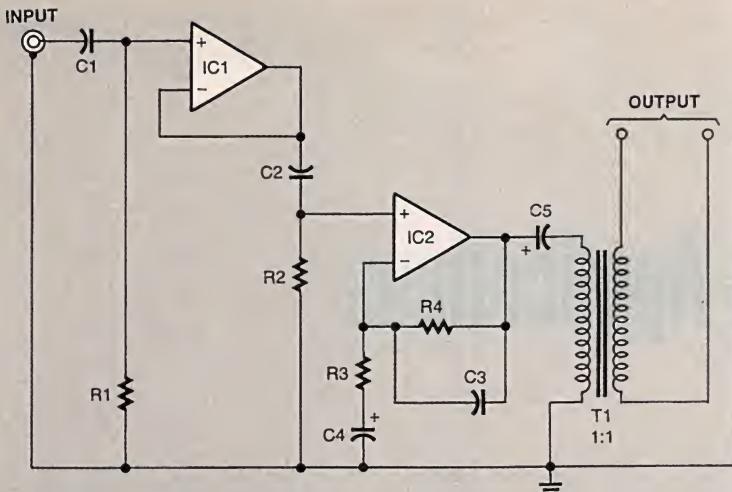
Now that we have confirmed that the real result matches the calculated one, let's try something different. Let's assume that we decide that the output should be flat at 20 Hz. That means that the -3-dB point must be moved to a lower frequency. The problem here is that we do not know what that frequency should be. But we can use the C-Box to easily solve this problem.

The same setup is used as above. If we look at the voltage output, we will see that it decreases as the value of capacitance increases. You can push the switches on the C-Box in and out and watch what happens at the meter. How close you get to a 0-dB loss is entirely up to you, the designer. I have found that replacing the 2 in the formula with a  $\frac{1}{4}$  is a good way to start, though that is just my rule of thumb. If you do the calculation, to get a 0-dB loss you will come up with a value of 636.61 nF for C1. Of course, we cannot replace the C-Box with a capacitor of that exact value at a reasonable cost. The tolerance of the capacitor we do use will determine the exact value. For example, a 1-mF-electrolytic capacitor with a 20% tolerance will work well. Be sure to observe the proper polarity when installing the capacitor.

## The High-Frequency End

The next capacitor to look at would be C3. It limits the high frequency of the op-amp system. The op-amp may be able to pass frequencies above 20 kHz, but there is little practical need for information above that frequency. As such, a good -3-dB point could be 30 kHz. Again use Equation 2 to solve for the needed value. Assuming a frequency of 30 kHz and a resistance for R4 of 100k, the answer is  $53.05 \times 10^{12}$ , or 53.05 pF. You cannot get that exact value with the C-Box. The closest value that you can get is 50 pF. Set up the C-Box for that value and test the circuit at the point where C5 connects to output of the IC2.

Next, set the audio oscillator to 30 kHz and put the level at +4 dBm. You should read a voltage of 1 dBm. Now look at the output when the frequency is set at 20 kHz. The voltage should be +4 dBm. If this is satisfactory, then you have



$$\text{EQUATION 1: } f = \frac{1}{2\pi RC}$$

$$\text{EQUATION 2: } C = \frac{1}{2\pi f R}$$

$$\text{EQUATION 3: } g = 1 + \frac{R_3}{R_4}$$

$$\text{EQUATION 4: } 20\log(\text{dB}) = 1 + \frac{R_3}{R_4}$$

**FIG. 1—HERE'S THE CIRCUIT WE'LL BE USING** to demonstrate one of the best uses of the C-Box, which is to verify the capacitor values that are obtained using the standard design equations.

made a good choice. If not, you must use a lower value of capacitance. You might try designing for 40 kHz. Then the capacitance value will be 39.78 pF (use 40 pF). Continue to take readings and experiment with values until you are satisfied.

### Setting The Low Frequency

The next capacitor in Fig. 1 that we need to look at is C4. It sets the low frequency of IC2. We will use Equation 2 again to calculate the value of the capacitor. But first we must calculate the value for resistor R3, which sets the gain of that op-amp. To do this we need to use Equation 3, or, if we already know the gain (specified in dBs), Equation 4. For this example, I selected a gain of 14 dB, and once again assumed a value of 100k for R4. That yields a resistance of 24,937 ohms for R3. For the sake of reality, use 24k. Plug that value into Equation 2, along with the frequency of 20 Hz, and your solution should be 331.5 nF.

Try that value in a real circuit and see how it works. Again, that is the -3-dB point. As resistance increases, the -3-dB point moves to a lower frequency. The exact value that you chose will depend on the use of the circuit. Use the C-Box to try different values and see what happens.

The final component that we will be dealing with in this circuit is C5, the output capacitor. That capacitor limits the low-frequency value. The only other factor that you do not know from Fig. 1 is the load impedance into which this circuit will work. Let us make two assumptions. First let's assume that the load impedance will be 600 ohms. Then let's look at a second load impedance at 10k. Again assuming a -3-dB point of 20 Hz, for the 600-ohm impedance the answer is 13.26 mF. As that value is out of the range of the C-Box, let's try 40 Hz instead of 20 Hz. That yields 6.63 mF, which can be set in the C-Box without any problems.

Now let's investigate an output impedance of 10k. Again use Equation 2 to solve for C. The answer is 795.7 nF. That value is easy for the C-Box. You might have noticed that the higher the impedance the lower the capacitor value. Knowing the load impedance with this capacitor is quite important. With this circuit you can investigate the effects of the capacitor on the frequency response. It will be a great learning experience for those of you that have not done this kind of work before. Practice makes perfect; experiment often and you will eventually be able to do this by instinct.

## NEW PRODUCTS

*continued from page 22*

### Computer & Monitor Maintenance, Inc.

6649-N Peachtree Industrial Blvd.  
Norcross, GA 30092  
Tel: 800-466-4411 or 770-662-5633  
Fax: 770-840-8814  
E-mail: [cmm@america.net](mailto:cmm@america.net)  
Web: [www.computermonitor.com/tv](http://www.computermonitor.com/tv)

### Optoisolation Unit

The continual appearance of new government regulations worldwide causes havoc with equipment suppliers. IEC 601-1 invokes higher limits of isolation for electronic equipment used in medical environments. That requirement led to Telebyte's development of the Model 269, IEC-compliant, Optoisolator.

Designed for medical electrical equipment, the Model 269 is a compact RS-232 to RS-232 optoisolation module that withstands 4000 volts AC for one minute and provides that level of isolation for the TD (Transmit Data), RD (Receive Data), and ground RS-232 signals.



CIRCLE 23 ON FREE INFORMATION CARD

The primary RS-232 port is a DB-25 male connector, which may be configured via switch selection as a DTE or DCE device. The secondary port is configured in an RJ-12 six-position modular jack with pins 3, 4, and 5 being Transmit Data, Receive Data, and Isolated Ground, respectively.

Packaged in a plastic case that measures 2 by 4.1 by 0.75 inches, the Model 269 retails for \$120.

### Telebyte Technology Inc.

270 Pulaski Road  
Greenlawn, NY 11740  
Tel: 800-835-3298  
Fax: 516-385-8184  
E-mail: [sales@telebyteusa.com](mailto:sales@telebyteusa.com)  
Web: [www.telebytetechology.com](http://www.telebytetechology.com)

# GET HERE.

## LEARN A SKILL YOU ENJOY... ...THEN FIND A JOB THAT HAS A FUTURE.

### **Everyone has to start somewhere.**

As 150,000 CIE graduates have discovered, independent study from The Cleveland Institute of Electronics can get you where you want to be. In a secure, financially rewarding, exciting career field of your choice.



**Industrial Robotics**

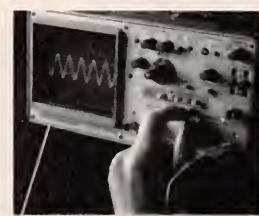
Since 1934, CIE has been on the forefront of an ever expanding technological revolution.

ment. CIE's curriculum is unique from other independent-study schools in the respect that we not only provide hands-on training utilizing today's technology we also instill the knowledge and understanding of why technology works the way it does. This is the foundation upon which every CIE graduate can trace their success back to and in which CIE's reputation as a quality learning facility is based on.



**Project Engineer**

Independent study is not for everyone. But, if you have the desire, the basic intellect and the motivation to succeed, CIE can make it happen. Our learning program is patented and each lesson is designed for independent study while our instructors are available to assist you whenever you feel you need help. In fact, CIE's curriculum is so well respected many Fortune 1000 companies utilize it for their own employees.



**Telecommunications**

CIE offers personalized training to match your background with over ten career courses, an Associate Degree Program and a Bachelor Degree Program through our affiliation with World College. And every CIE graduate got started

in a successful career the same way you can...by sending for your free CIE course catalog and judging for yourself if CIE's for you.



**Electronics**

Back then it was radio and TV, today it's computer technology, programming and the electronics that make it all possible. Today and yesterday's similarities are

uncanny... Employers are looking for qualified applicants to hire and having a hard time finding them.

Students at CIE receive the training and the education needed to get hired and to succeed in challenging fields such as computer programming, robotics, broadcast engineering, and information systems management.

# START HERE...

**YES!** Please send me more information on:

- CIE's Associate Degree Program
- CIE's Computer Programming Course
- CIE's 12 Career Courses
- World College's Bachelor Degree Program

AE116

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

Phone: \_\_\_\_\_

Check for G.I. Bill Details

Active Duty  Veteran



**Computer Programming**

# CIE

*It's More Than Just Training...  
...It's an Education.*

1776 East 17th Street  
Cleveland, OH 44114  
(216) 781-9400 • 1-800-243-6446

# RETAILERS THAT SELL OUR MAGAZINE MONTHLY

## California

California Electronics  
221 N. Johnson Ave.  
El Cajon, CA 90202

Ford Electronics  
8431 Commonwealth Avenue  
Buena Park, CA 90621

All Electronics  
14928 Oxnard Street  
Van Nuys, CA 91411

Gateway Electronics of CA  
9222 Chesapeake Drive  
San Diego, CA 92123

Mac's Electronics  
191 South "E" Street  
San Bernardino, CA 92401

Electronics Warehouse  
2691 Main Street  
Riverside, CA 92501

Orvac Electronics  
1645 E Orangethorpe Ave.  
Fullerton, CA 92631

Sav-On Electronics  
13225 Harbor Blvd.  
Garden Grove, CA 92643

JK Electronics  
6395 Westminster Blvd.  
Westminster, CA 92683

Marvac Dow Electronics  
980 S. A Street  
Oxnard, CA 93030

Kandarian Electronics  
1101 19th Street  
Bakersfield, CA 93301

Whitcomm Electronics  
105 W. Dakota #106  
Clovis, CA 93612

Marvac Dow Electronics  
265-B Reservation Road  
Marina, CA 93933

Minuteman Electronics  
37111 Post St., Suite 1  
Fremont, CA 94536

HCS Electronics  
6819 S. Redwood Drive  
Cotati, CA 94931

Halted Specialties Co.  
3500 Ryder Street  
Santa Clara, CA 95051

Metro Electronics  
1831 J Street  
Sacramento, CA 95814

HSC Electronics  
4837 Amber Lane  
Sacramento, CA 95841

## Colorado

Gateway Electronics of CO  
2525 Federal Blvd.  
Denver, CO 80211

Centennial Electronics  
2324 E. Bijou  
Colorado Spgs., CO 80909

## Connecticut

Cables & Connectors  
2198 Berlin Turnpike  
Newington, CT 06111

Electronic Service Prod.  
437 Washington Avenue  
North Haven, CT 06473

## Georgia

Norman's Electronics, Inc.  
3653 Clairmont Road  
Chamblee, GA 30341

## Illinois

Tri State Elex  
200 W. Northwest Hwy.  
Mt. Prospect, IL 60056

## Kansas

Electronic Hobby Shop  
309 E. McKay  
Frontenac, KS 66763

## Maryland

Mark Elec. Supply Inc.  
5015 Herzl Place  
Beltsville, MD 20705

Amateur Radio Center  
1117 West 36th Street  
Baltimore, MD 21211

## Massachusetts

U-Do-It Electronics  
40 Franklin Street  
Needham, MA 02194

## Michigan

Purchase Radio Supply  
327 East Hoover Avenue  
Ann Arbor, MI 48104

Norwest Electronics  
33760 Plymouth Road  
Livonia, MI 48150

The Elec. Connection  
37387 Ford Road  
Westland, MI 48185

Elec. Parts Specialists  
711 Kelso Street  
Flint, MI 48506

## Minnesota

Acme Electronics  
224 Washington Avenue N.  
Minneapolis, MN 55401

## Missouri

Gateway Electronics Of MO  
8123-25 Page Blvd.  
St. Louis, MO 63130

## New Jersey

Lashen Electronics Inc.  
21 Broadway  
Denville, NJ 07834

## New York

R&E Electronics  
4991 Rt. 209  
Accord, NY 12404

Unicorn Electronics  
Valley Plaza  
Johnson City, NY 13790

## Ohio

Philcap Electronic Suppliers  
275 E. Market Street  
Akron, OH 44308

## Oregon

Norvac Electronics  
7940 SW Nimbus Avenue  
Beaverton, OR 97005

Taztronics  
257 N. Wasson St.  
Coos Bay, OR 97420

## Pennsylvania

Business & Computer Bookstore  
213 N. Easton Road  
Willow Grove, PA 19090

## Texas

Mouser Electronics  
958 N. Main Street  
Mansfield, TX 76063

Tanner Electronics  
1301 W Beltline  
Carrollton, TX 75006

Electronic Parts Outlet  
3753 B Fondren  
Houston, TX 77063

Electronic Parts Outlet  
17318 Highway 3  
Webster, TX 77598

## Washington

Amateur Radio Supply Co.  
5963 Corson Ave., Ste 140  
Seattle, WA 98108

## Wisconsin

T.V.-VCR Repair  
1306 W. Madison St.  
P.O. Box 64257  
Milwaukee, WI 53204

If you'd like to sell our magazine in your store,  
please circle 210 on Free Information Card.



# BUILD A HIGH- PERFORMANCE LOGIC ANALYZER

*Turn any computer into a high-speed, high-performance, expandable logic analyzer that can grab samples at up to 40 million per second!*

**O**ne of the most useful tools for anyone working with digital electronics is a logic analyzer. Of course, a logic analyzer is also very expensive. There have been several designs for personal-computer-based logic analyzers that connect directly to the computer's printer port. While those devices are very useful and low in cost, they suffer from a fairly low sampling rate and a limited number of channels that can be sampled.

The PC-based logic analyzer presented here, although a bit more expensive than those other units, has most of the features of the even more expensive commercial units. It features a 40-MHz maximum sampling rate with ten clock-speed selections—eight that are internal and range from 40 MHz to 312.5 kHz, and two external inputs. A total of 16 channels can be sampled simultaneously. The triggering is controlled by an 8-bit trigger word that includes high-level triggering, low-level triggering, and "don't care" states for each channel. A total of three triggering modes are provided. The sampled data is stored in a 2048-word memory buffer that is transferred to the PC after the sampling is completed.

In addition to those basic fea-

tures, the logic analyzer is designed to be expandable. Other features and devices can be plugged into the logic analyzer for uses that a logic analyzer can not be used for by itself. For example, a future article will describe how to build an expansion module that will turn the logic analyzer into a full-featured digital-storage oscilloscope!

**Theory of Operation.** In general, a logic analyzer works by taking a sample of a set of digital signals at set time intervals after a certain triggering condition appears on the inputs. When the analyzer is triggered, the samples are read and stored for later viewing. The analyzer board has five main functional blocks: the PC interface, clock generation, data storage, trigger control, and 5-volt power supply. The schematic diagrams in Figs. 1 and 2 show how the circuit is put together. In order to keep the PC Board size down, the circuit is designed around two programmable-logic devices. A Lattice Semiconductor ispLSI1016E Complex PLD (or CPLD) is used for IC1. The ispLSI1016E holds a lot of digital logic within its 44-pin PLCC package. The particular programming that is used in the logic analyzer design is equivalent to

about a dozen standard TTL chips. An additional PLD is used for IC2. That chip replaces about 4 standard TTL chip's worth of logic. Those two PLDs handle most of the logic on the analyzer board. Since much of the logic is contained in IC1, it plays a part in most of the different functional blocks.

The PC interface connects to any standard printer port through J1; a bi-directional port is not needed. All 12 output signals (8 data lines and 4 control signals) on the port are used by the analyzer. Four of the five possible inputs to the PC are used to read data and status information from the analyzer circuit. Each signal is terminated using a resistor-capacitor pair to make sure that the signal does not become garbled in any way. The signals that are edge sensitive are further buffered by IC9, a 74HCT14 hex inverter. The 74HCT14 is a Schmitt-trigger device that has "hysteresis" on the inputs. That causes the outputs to "snap" on or off even if the inputs rise or fall slowly. That action cleans up any poor-quality signals.

The software running on the PC passes information to and from the logic-analyzer board using a simple addressing method. Three address

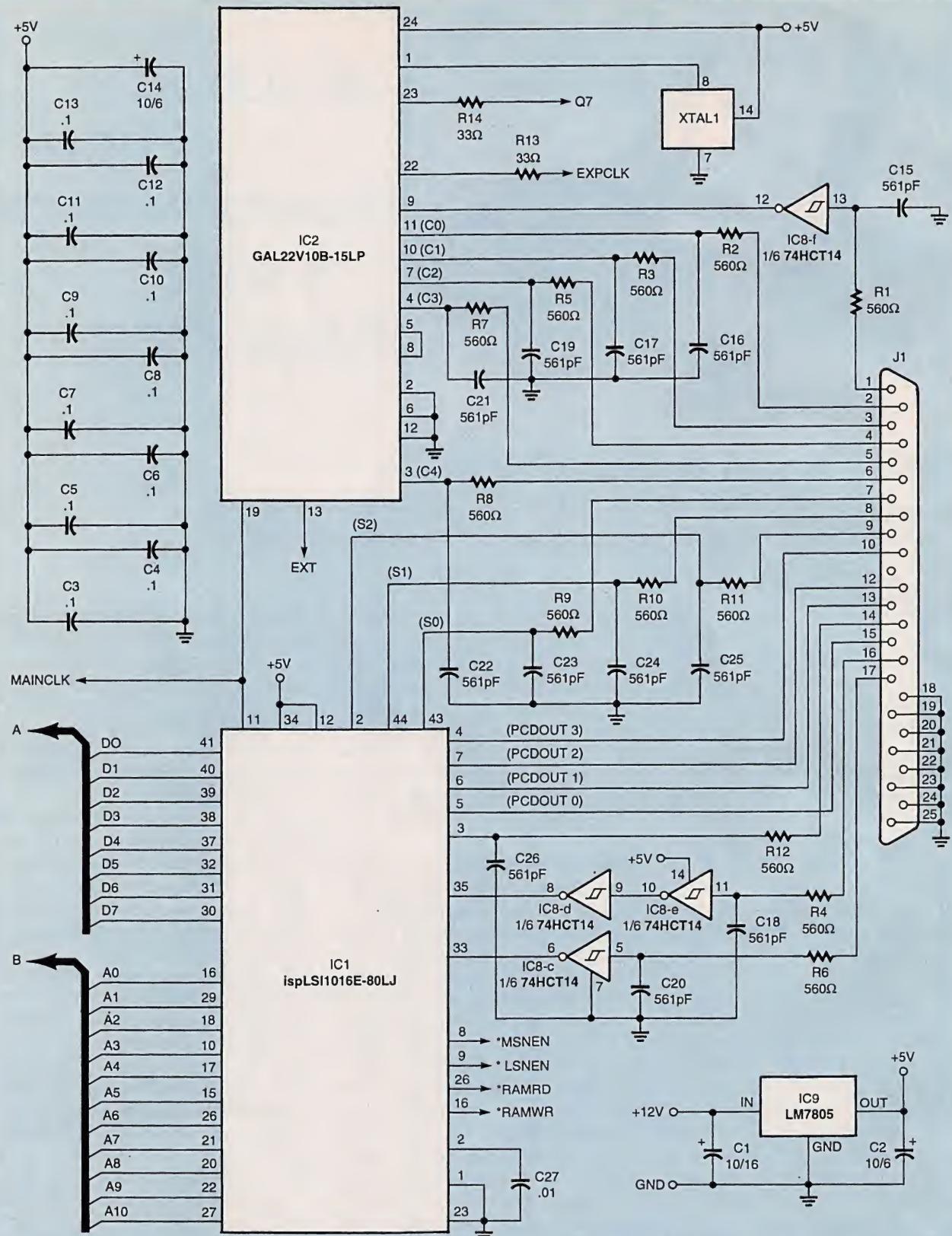


Fig. 1. The circuitry of the Alta Engineering Logic Analyzer is simplified by the use of programmable-logic devices (PLDs) that can replace a dozen or more individual integrated circuits.

signals are used to select one of eight address locations on the analyzer board. Once the address is

set, the PC can read information from the signals PCDOUT0, PCDOUT1, PCDOUT2, and PCDOUT3

through the printer control register. Table 1 shows the different addresses and the information that is

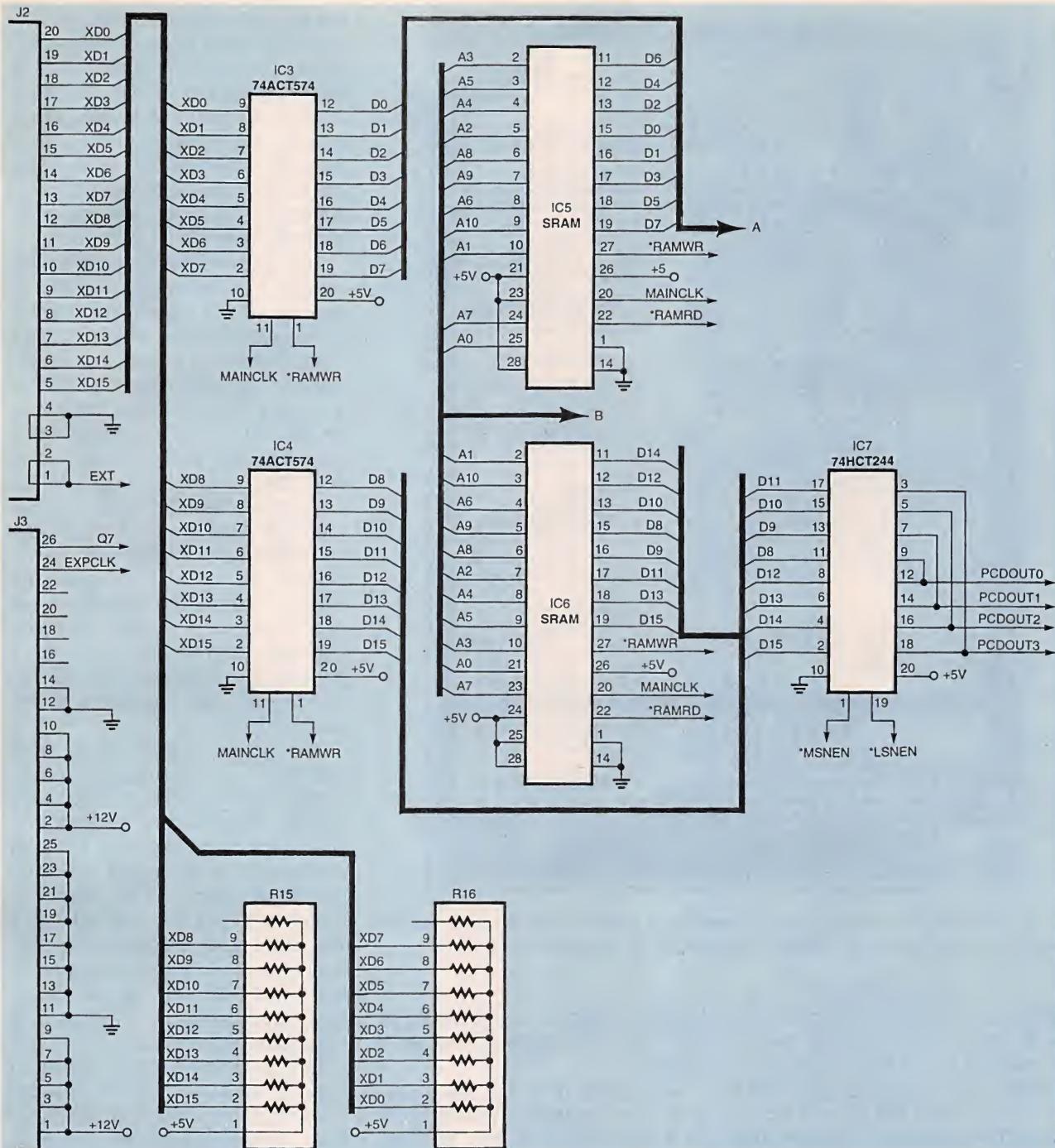


Fig. 2. The logic analyzer uses high-speed static Random-Access Memory (RAM) to store the collected samples at rates up to 40 MHz.

passed to the computer.

The signals D0-D7 and A0-A10 are the same signals indicated in Figs. 1 and 2. Those signals are routed through IC1. The T7, STOP, TRIG-VALID, and WRAP signals are generated by IC1 itself. Signals D8-D15 are routed through IC7. The signals \*LSNEN and \*MSNEN are generated by IC1 to control the transfer of data through IC7.

For the PC to write data to the logic analyzer requires only a slightly more complex procedure. Again, the control signals S0-S2 are used to select the address according to Table 2. Once the address has been selected, the data is transferred serially one bit at a time. Each bit from the PC is placed on pin 3 of IC1. The transfer takes place on the rising edge of the clock signal on pin 33 of IC1. For example, the trigger data (T7-T0 and X7-X0) is loaded into IC1 by placing the value for T7 on pin 3 of IC1, and then toggling the clock line on pin 33. That procedure is repeated for T6, T5, etc. to T0, then X7, X6, and so on until X0 has been transferred.

One of the key parts of the logic analyzer circuit is the clock generator for timing the sample interval. The

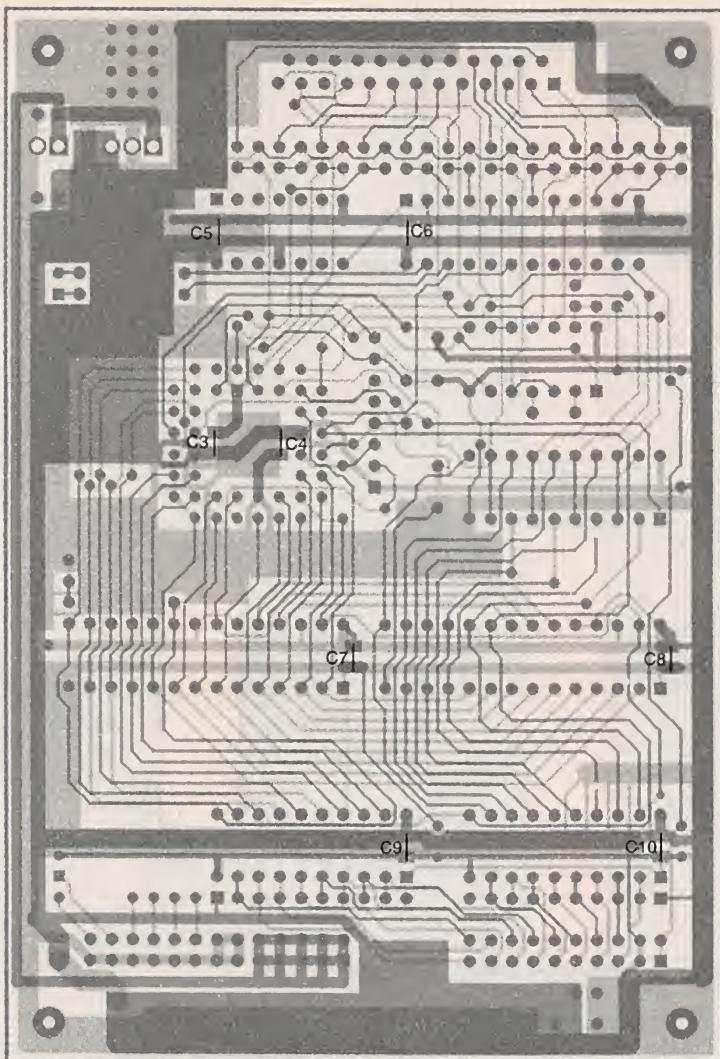


Fig. 3. The solder side of the logic analyzer board has a handful of surface-mount capacitors attached to it. Those components should be mounted before the through-hole components.

master clock is generated by XTAL1, an 80-MHz crystal oscillator that is connected to IC2. The master clock is divided by the logic programmed into IC2 to make the sample clocks from 40 MHz down to 312.5 kHz. The system clock that is used is selected by the signals C0-C4, which come from the PC. In addition to the internally-generated clock frequencies, the EXT signal can be a clock from an external source—usually from the system under test. An additional clock input from the PC to pin 9 of IC2 lets the software control the clock for retrieving data, control, and diagnostic functions. Regardless of the clock division selected by C0-C4, whenever the signal on pin 9 of IC2 is low, the MAINCLK signal is held low. That lets the PC turn the

MAINCLK signal on and off. The possible clock selections are shown in Table 3.

Two signals from IC2 are routed to J3, the expansion connector. Pin 26 is connected to the 312.5-kHz clock and pin 24 is connected to the MAINCLK signal. Neither of those signals are used within the logic analyzer circuit, but will be used by future expansion modules.

During data capture, the outputs of IC3 and IC4 are enabled and data is strobed into the flip-flops from the probe assembly on the rising edge of the system clock. The system clock is also connected to the chip-select inputs of static RAMs IC5 and IC6. The captured data is written to the RAMs on the low half of the system clock cycle. The RAM

address, A0-A10, is handled by IC1. On each rising edge of the system clock, IC1 increments the address by 1. When the address exceeds 2047 (or 7FF hex), the address wraps around to 0. In this way, data is continuously stored in successive RAM locations. When IC1 is reset (through pin 35), the address lines are automatically set to 0.

The trigger-control circuit is handled by IC1. The trigger condition is defined by two eight-bit patterns—a trigger pattern and a “don’t care” pattern. The test for a trigger condition is performed on each of the data bits in parallel. We’ll look at just bit 0 in order to understand how the test works. If the “don’t care” bit is 0, then the trigger will be valid when the trigger bit matches the logic level on D0. If the trigger bit is set, say, to 1, then a high level on D0 will cause a trigger. Of course, a 0 on the trigger bit will only activate the trigger if D0 is low. With the “don’t care” bit set to 1 instead, the trigger for that bit will always be valid regardless of the level of D0.

The trigger control checks eight bits at the same time. The match pattern and the “don’t care” pattern can be mixed in any combination needed. The logic in IC1 checks for a match to the trigger condition on each clock cycle. When a match is found, the internal signal TRIGVALID is set, beginning the capture routine. An internal counter in IC1 keeps track of how many samples have been stored. When the counter reaches a value of 3FF hex (1023), all sampling is stopped and a signal is set to let the PC software know that all of the samples have been saved. In that way, the logic analyzer’s memory will be holding 1024 samples before the trigger condition was met and 1024 samples after the circuit was triggered.

Once the data acquisition has stopped, the stored data must then be read from the logic analyzer to the PC. The PC reads the last address from the logic analyzer 4 bits at a time through the interface. The PC then resets IC1 and selects the PC-controlled clock on IC2. The RAMWR signal is cleared, which disables the outputs on IC3 and IC4, and puts the RAM ICs into the read

## PARTS LIST FOR THE ALTA ENGINEERING LOGIC ANALYZER

### SEMICONDUCTORS

IC1—ispLSI1016E-80LJ programmable-logic device, integrated circuit (Lattice Semiconductor)  
 IC2—GAL22V10B-15LP programmable-logic device, integrated circuit  
 IC3, IC4—74ACT574 octal flip-flop, integrated circuit  
 IC5, IC6—8K×8 static RAM, 12 nanosecond, integrated circuit  
 IC7—74HCT244 octal buffer, integrated circuit  
 IC8—74HCT14 hex Schmitt trigger, integrated circuit  
 IC9—LM7805 5-volt regulator, integrated circuit

### RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted)  
 R1—R12—560-ohm

R13, R14—33-ohm

R15, R16—1-megohm, 10-pin single-inline package, resistor network

### CAPACITORS

C1—10- $\mu$ F, 15-WVDC, electrolytic  
 C2, C14—10- $\mu$ F, 6-WVDC, tantalum  
 C3—C10—0.1- $\mu$ F, ceramic, surface-mount  
 C11—C13—0.1- $\mu$ F, ceramic-disk  
 C15—C26—561-pF, ceramic-disk  
 C27—0.01- $\mu$ F, ceramic-disk

### ADDITIONAL PARTS AND MATERIALS

J1—DB25 female connector, PC-mount  
 J2—20-pin male header  
 J3—26-pin male header  
 J4—coaxial power jack  
 XTAL1—80-MHz oscillator  
 Heat sink for IC9, socket for IC1, 12-

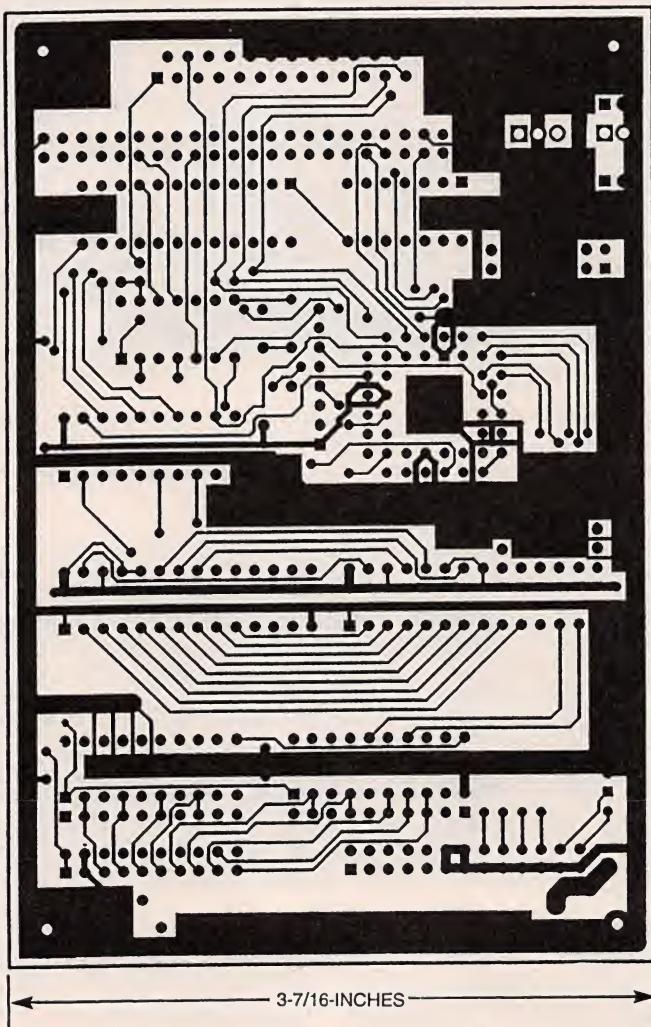
volt wall transformer, 20-conductor ribbon cable, 20-pin insulation-displacement connector, test clips, DB25 male-to-male cable, PC board, wire, solder, hardware, case, etc.

**Note:** The following items are available from: Alta Engineering, 58 Cedar Lane, New Hartford, CT 06057-2905; Tel: (860)489-8003; e-mail: alta@gutbang.com; Web: www.gutbang.com/alta; Software on 3 1/2-inch diskette, \$10.00; Blank PC board, \$45.00; Complete board-only kit with software, \$139.00; Complete board-only kit with case and software, \$169.00; Complete kit with power supply, probe kit, and cable, \$209.00. Please include \$5.00 for shipping and handling within the US; \$10.00 (US) for international orders. CT residents should add appropriate sales tax.

mode. The data is then read 4 bits at a time from each address starting at 0. After the data at a given address is read, the PC pulses the diagnostic/control clock on IC2 in order to increment the address counter to the next location. Once all of the data has been read from all of the RAM addresses, the PC program can then display the data.

The final section is the power supply. A 12-volt DC wall transformer rated at 800 mA provides power for the unit. The logic analyzer uses about 450 mA of regulated 5-volt current. That is supplied by IC9, a 7805 regulator. A heat sink is needed on IC9 to prevent overheating of the device. The expansion connector also has connections for the unregulated 12-volt supply so that other expansion modules can be powered by the wall transformer.

**Building the Logic Analyzer.** Before building the logic analyzer, get a copy of the software from the Alta Engineering web site ([www.gutbang.com/alta](http://www.gutbang.com/alta)) or the **Electronics Now** ftp site (<ftp://ftp.gernsback.com/pub/EN/altalog.zip>). You will need the software for both programming the PLDs and testing the analyzer. The program also doubles as a demo so you can see the capabilities of the unit before actually building it. Also, any last-minute suggestions or details that do not



Here is the component side of the logic analyzer board. If you will be making your own board and you will not be plating the holes, you will have to solder the connections on both sides of the board.

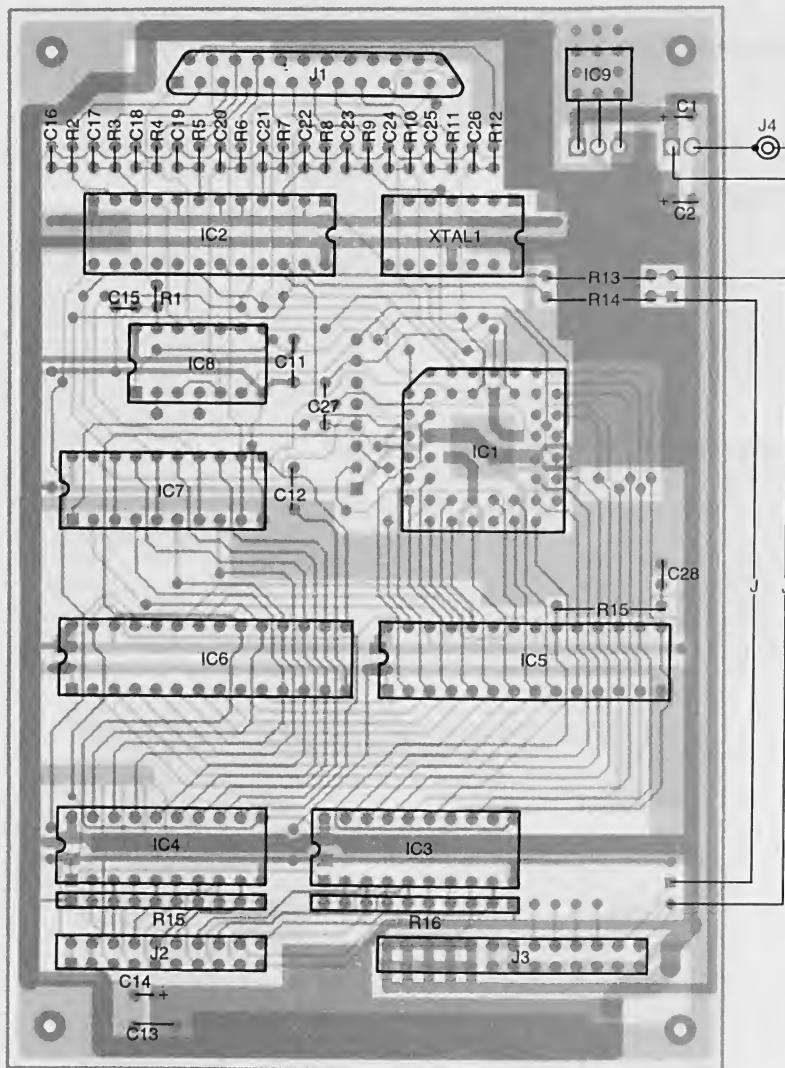


Fig. 4. The logic analyzer board has a neat, clean layout thanks to the use of PLDs to keep package count to a minimum. Be careful of IC orientation—some of the parts face in different directions. The jumper wires should be mounted on opposite sides of the board in order to minimize crosstalk between the signals they will be carrying.

Table 1

S2	S1	S0	PCDOUT3	PCDOUT2	PCDOUT1	PCDOUT0
0	0	0	D3	D2	D1	D0
0	0	1	D7	D6	D5	D4
0	1	0	A3	A2	A1	A0
0	1	1	A7	A6	A5	A4
1	0	0	T7	A10	A9	A8
1	0	1	STOP	TRIGVALID	WRAP	
1	1	0	D11	D10	D9	D8
1	1	1	D15	D14	D13	D11

make it into print will be included with the software.

The analyzer should only be built on a double-sided PC board with plated-through holes. The layout is very critical, so no other construction method is likely to work. You

can make your own PC board from the foil patterns given here, or one can be purchased from the source given in the Parts List.

A small, low-wattage soldering iron should be used to assemble the board. Start by soldering the sur-

face-mount capacitors onto the bottom of the board. The locations of those components are shown in Fig. 3. A simple method of soldering those parts is to first coat one of the pads with some solder. While holding the component in place with a small screwdriver, touch the same pad lightly with the soldering iron. The solder will re-melt and tack the capacitor in place. Carefully check the position of the capacitor to be sure it is properly seated on the pads. Now is the time to fix any alignment errors. If the part is properly aligned, solder the other end of the capacitor in place. Finally, go back to the first end and re-flow that solder joint. After each capacitor is soldered in place, use an ohmmeter to check between the 5-volt and ground traces to verify that it remains an open circuit. Checking for shorts each time will help catch and correct any errors. The rest of the remaining capacitors and the resistors can now be mounted using the parts-placement diagram in Fig. 4 as a guide. Most of the resistors must be mounted vertically to fit into the available space.

Before mounting IC9, slide the heat sink onto the regulator. Make a 90-degree bend in the leads at the point where they taper down. Mount the regulator so that the heat sink hangs over the end of the PC board. Once IC9 is soldered in place, connect a short pair of insulated wires and J4. Feed the wires through a rubber grommet if the unit will be mounted in a case. Before mounting any semiconductors, hook up the transformer and verify that 5 volts is present between the power and ground pins at each IC location.

The remainder of the parts can now be mounted. Although sockets are optional for the integrated circuits, a socket must be used for IC1. Be very careful about the location of pin 1 on all of the ICs—some components face in different directions on the board. The two jumpers should be installed on opposite sides of the PC board in order to reduce crosstalk between the signals that they will carry.

**The Probe Assembly.** While you can purchase the probe assembly

At NRI,  
It Is Possible  
to Please  
All of the People  
All of the Time!



SEE REVERSE SIDE FOR NEW GAME PROGRAMMING COURSE!

Whether you're a beginner, a programming expert, or just want to brush up on some of today's hottest programming languages, NRI has tailor-made study courses to meet your needs ... no matter what your skill level, no matter what your background.

### Choose the Level of Training You Need

Choose NRI's career-level programming course, and you train hands-on with a powerful 200 MHz Pentium® processor-based PC, featuring MMX™ technology, 1.6 gigabyte hard drive, 8X CD-ROM drive, 33,600 baud fax/modem, and more! Or, choose only those portions of the complete course you need to meet your specific training objectives. The choice is yours!

### Program Like a Professional

Our popular Computer Programming course covers all the essentials — everything from designing to coding to debugging. As you move through your course, you'll have the opportunity to study in depth one of three programming languages — Visual Basic, C++, or Java. Fast, flexible, and easy to use, these three programming languages are revolutionizing business and opening new opportunities in the computer field.

**C++** — Famous for its outstanding flexibility and speed, C++ is a versatile language more and more businesses are finding they can't do without. In this course, you get a first look at the principles of object-oriented programming and the methods that save you time and make

programming easier. Learn this language's pitfalls and pleasures, including how to write tight, fast code, how to debug, and how to create super-fast applications that avoid program and syntax errors.

**Java** — In response to the problems in adapting existing languages to Web programming, JAVA was designed specifically for programming the Internet. Easy to use and reliable, JAVA gets quick results with a minimum of user frustration. This course provides an overview of how JAVA is used and then focuses on the programming language itself. Soon, you'll know how to work with Java code, how to create applets and applications, and more.

**Visual Basic** — Efficient and accessible, Visual Basic is an object-oriented,

event-driven language that has adapted to the changing needs of business and the changing standards of program design.

**Introduction to Visual Basic:** In this step-by-step introductory course you'll discover the fundamentals of program structures and the techniques necessary to write programs in sophisticated languages. By the end of your training, you'll be conversant in data and decision structures, arrays and loops, arithmetic functions, graphics and sound, file management, and more!

**Advanced Visual Basic:** For programmers already adept in Visual Basic, this course gives you advanced techniques, including how to create text boxes, use Active X for Internet programming, manage files, create various window applications, and more!

MAIL CARD TODAY FOR YOUR FREE COLOR CATALOG OR CALL 1-800-321-4634

Ext. 2999

**Check one FREE catalog only.**

Computer Programming (with concentrations in Java, Visual Basic, or C++)

Game Programming Fundamentals

Multimedia Programming

Networking with Windows NT

PC Applications Specialist

Mastering Microsoft Office

PC Servicing

**NRI Schools**  
4401 Connecticut Avenue, NW  
Washington, DC 20008

OR GET YOUR AAS DEGREE!

Accounting  
 Business Management  
 Computer Science  
 General Studies

Name \_\_\_\_\_ (please print) \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Accredited Member, Distance Education and Training Council

5415-0398

A Division of The McGraw-Hill Companies

# Check Out the NRI Advantage ...

## Quality Service

- We have the benefit of years of training experience, with over 1,500,000 students since 1914.
- We offer tailor-made study programs, where you call the shots, set your own pace, and initiate your own solutions.
- Our study lessons are flexible, convenient, and cutting edge, with software you can experiment with on a Pentium® 200 MMX™ computer you train with and keep.
- Our instructors are informed, personable, and committed to your success.
- The quality of our service has been tested and proved ... your satisfaction is guaranteed.
- Accreditation from the DETC (Distance Education and Training Council) means your training is administered according to the highest standards.

## Hardware

- Pentium® 200 MHz processor
- MMX™ technology
- 16 meg RAM
- 1.6 gigabyte hard drive



SEND TODAY FOR YOUR FREE CATALOG!



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

## BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 10008 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

**NRI** Schools

4401 CONNECTICUT AVENUE NW  
WASHINGTON DC 20078-3543



## Software

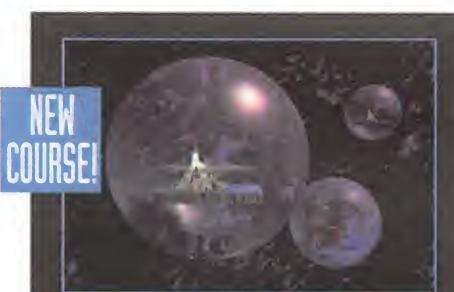
### Norton Interactive CD-ROM

— Designed by acclaimed software developer Peter Norton, this unique training tool has realistic simulations, special effects, full-color graphics, and role-playing lessons.

**Programming Compilers** — Now you can compile your programs into easy formats so that others can run your applications, too! Choose your own

programming compiler for Visual Basic, C++, or Java.

**Windows 98 Upgrade** — This long-awaited new version of Windows has more power, a new Web look, e-mail capabilities, single-click functionality, and System File Checker.



## GAME PROGRAMMING FUNDAMENTALS

Learn programming the easy way in this new course featuring graphic simulations, animation, and sound effects. Not only will you learn the fundamentals of game programming, but you'll also gain an in-depth understanding of your choice of programming languages: Visual Basic, C++, or Java. An exploding field in programming, computer gaming has a strong and growing market among the MTV-generation. This course teaches you how a popular computer game was written, from storyboarding to coding. In addition to covering game design, performance, and debugging, you'll gain hands-on experience as you make direct modifications to the game itself.

*Please note: You must own a PC and be computer literate in order to take this program. A personal computer is not included.*

Card 71

**Table 2**

S2	S1	S0	Function
X	0	0	Trigger data T7-T0 then X7-X0
X	0	1	Not Used
X	1	0	Trigger sequence/ length/mode

parts from the source given in the Parts List, it is a good idea to make your own probe assembly. That way, the assembly can be customized to your own requirements. Start by mounting a length of 20-conductor ribbon cable to an insulation-displacement connector. The cable should not be more than 18 inches in length; keeping the length as short as possible is better for both signal integrity and keeping the cables from getting tangled. If you are not sure what length you will be needing, 12 inches is a good starting point. A total of 18 clips will be needed—one for each data input, plus one for ground and one for the external clock signal. There are many choices for the clips—the ideal choice depends on the type of circuits that you will be testing. Several different probe assemblies with different lengths and probes can be made for different needs.

Following the diagram in Fig. 5, solder the clips to the ribbon cable. Split conductors 1 and 2 off from the rest of the cable. Solder both conductors 1 and 2 onto a clip and label that clip "CLOCK". Next, split wires 3 and 4 off and solder both of them onto a clip—that will be labeled "GROUND." Starting from conductor 20, separate each wire from the cable and solder it onto a clip. The labels will go from "0" to "15" (conductor 20 is labeled "0"). The cable should be split most of the way down the connector. If it is not split, the result will be crosstalk between the adjacent wires. Of course, the wires might become a tangled mess with use—just like an expensive analyzer. Unfortunately, there doesn't seem to be a good way to keep the probe wires neat without bundling them together and getting crosstalk.

### Testing the Logic Analyzer

Double-check all of the solder joints and connections one more time. When you are completely sure

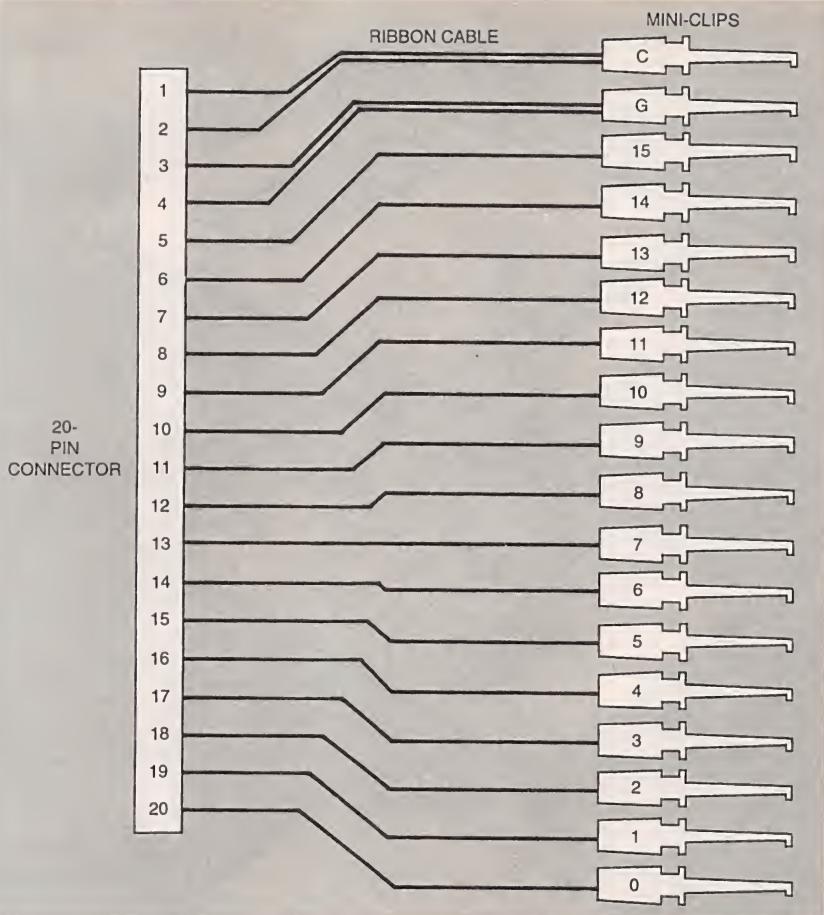


Fig. 5. The probe assembly is easily made from a length of ribbon cable and a handful of test clips. Note that two of the clips have two wires each attached to them.

**Table 3**

C4	C3	C2	C1	C0	MAINCLK
0	0	0	0	0	40 MHz
0	0	0	0	1	20 MHz
0	0	0	1	0	10 MHz
0	0	0	1	1	5 MHz
0	0	1	0	0	2.5 MHz
0	0	1	0	1	1.25 MHz
0	0	1	1	0	0.625 MHz
0	0	1	1	1	0.3125 MHz
0	1	0	0	0	EXT clock
1	0	0	0	0	EXT clock inverted
1	1	0	0	0	Software clock

about your work, plug in the power supply. Using a voltmeter, check to see that there is 12 volts at the expansion connector and that there is 5 volts between each IC's ground and power pins. Disconnect the power from the board. Connect the board to a printer port on a PC using a DB25 male-to-male cable with all conductors wired straight through (pins 1 to 1, 2 to 2, etc.). The cable should be 6 feet or less in length. Since there is a possibility

that a defective logic analyzer could damage the printer port circuitry in the computer, you should not use a laptop computer with the analyzer until the analyzer has been given a clean bill of health. Start the computer and apply power to the analyzer board. Run the ALTAGO program. Select F9 to configure the program. Select the LPT port that the analyzer is connected to and then press any key at the prompt. The LPT port selection is stored in the config-

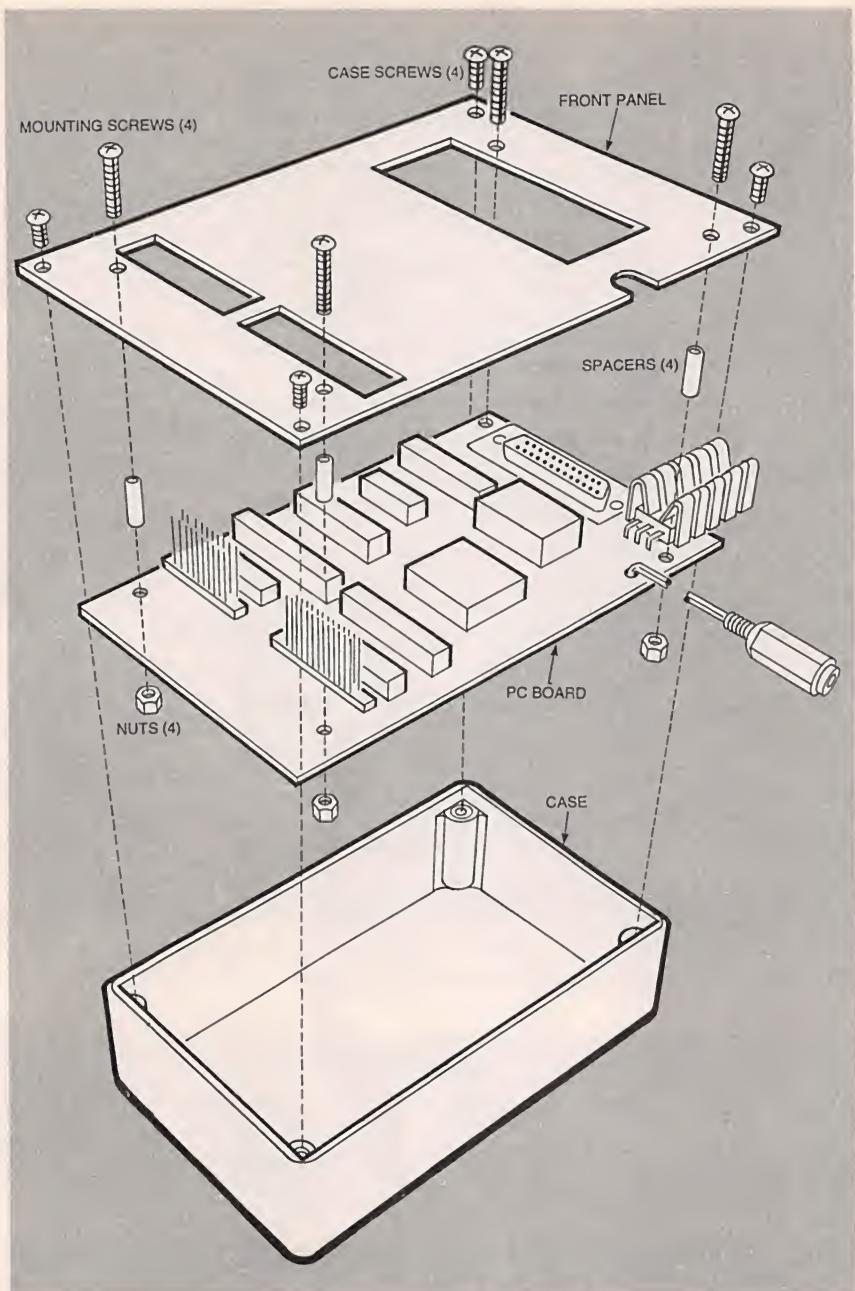


Fig. 6. Mounting the logic analyzer board in a suitable enclosure is very simple and straightforward. Don't forget to use a rubber grommet on the power leads if you are using a case with a metal front panel.

uration file ALTALOG.CFG.

The logic analyzer will be tested by using it on its own signals. Connect probe 0 to pin 26 on the expansion connector, and connect probe 1 to expansion connector pin 25. Those pins are toward the outside edge of the board. Do not connect the probe to the expansion-connector pins on the inside of the board—those pins carry 12 volts and will damage IC3 and IC4. Press F5 on the computer keyboard to acquire data. In a few seconds, acquiring

the data should be complete and the menu will return. Press F6 to look at the state display of the data. The data is shown in binary toward the right side of the screen. Bit 1 (second from the right) should read 0 all the way up and down the page. Bit 0 (all the way on the right) should alternate between 64 zeros and 64 ones. Use the PageUp and Page-Down keys to scan through the data and verify that the data has been captured correctly. If that is correct, most of the logic analyzer is working.

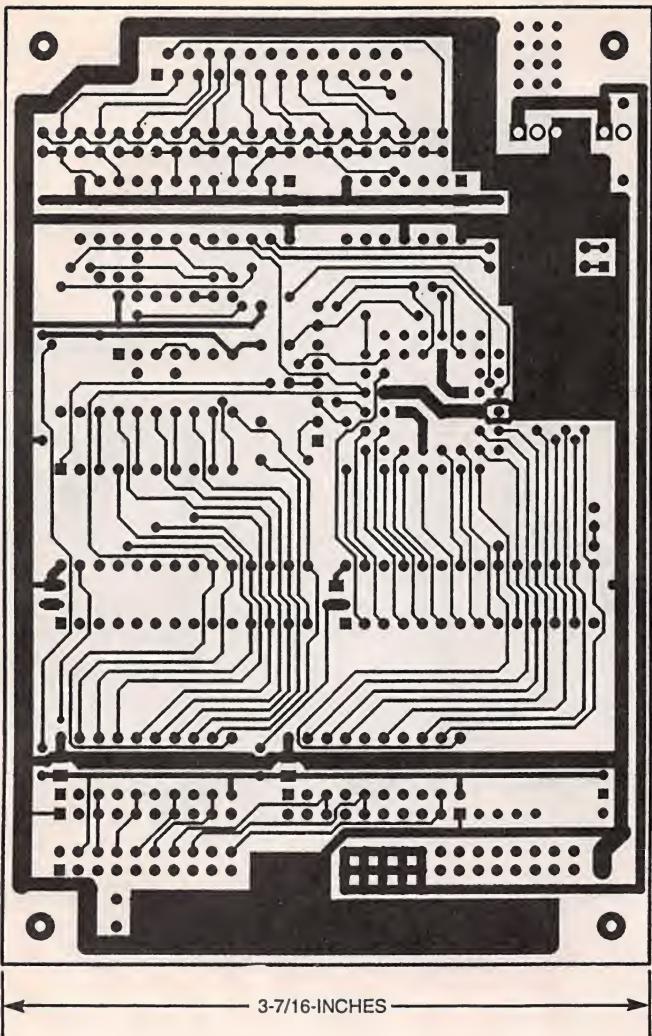
Additional testing will be done while learning how to use the analyzer. If you run into problems, you might have a cable problem, the wrong LPT port selected, or a board problem. The diagnostic program ALTADIG that is described in the text file ALTADIG.TXT will do some additional board troubleshooting. All of those files are included in the main file archive that was downloaded.

Once the logic analyzer passes its initial tests, the board can be mounted in a suitable enclosure. A method is shown in Fig. 6. Suitable holes are cut in the front panel for the three connectors and the power lead. The board is simply bolted to the back of the front panel using screws, nuts, and spacers. Any kind of labeling on the front panel to help identify the various pins and functions will help make the project more professional-looking.

**Using The Logic Analyzer.** There are a few non-obvious points that you should be aware of when using the logic analyzer. Always power up the logic analyzer before connecting the probes to the circuit under test. Hooking up a powered circuit when the logic analyzer is turned off can overheat and possibly damage IC3 and IC4. Another very important point is to make sure that there is no AC potential between the grounds of the circuit and the logic analyzer.

Like the initial test, we're going to use the analyzer on itself. Start the ALTALOG program and wait for the main menu to appear. As before, connect probe 0 to expansion connector pin 26 and probe 1 to expansion connector pin 25. This time, connect probe 2 to expansion connector pin 23 and probe 3 to expansion connector pin 21. We will not be needing the "ground" or "clock" probes.

Using menu choice F1, set the "A," or main, trigger to be XXXX XXX1, meaning that we want to trigger when probe 0 is high and we don't care about the state of the other bits. Press F2 to set up a "B" trigger condition and enter XXXX XXX0. With two different trigger conditions set, select the trigger mode with F3. The choices are



The solder side of the logic analyzer board has special pads for the surface-mount capacitors.

using the "A" trigger for one clock, the "A" trigger for two clocks, or the "A" trigger followed by the "B" trigger. For now, select the first option ("A" for one clock). We'll choose a 5-MHz clock rate with F4. Press F5 to start collecting data. Within a few seconds, the collection will be complete, and the program will return to the main menu.

Select F6 to view the data just gathered. For each clock cycle, the state display shows the clock-cycle number relative to the trigger point. The trigger point is clock-cycle zero; negative numbers are clock cycles before the trigger, and positive numbers are the cycles after the trigger. The next number is the time in microseconds relative to the trigger. The actual data is displayed two ways—first in hexadecimal and then in binary (remember, probe 15 is the

most-significant bit, probe 0 the least). At the trigger point, we should see 0 0.000 XXX1 xxxx xxxx xxxx 0001 (the x is used to represent an unknown value because we did not connect probes 8-15). You can move forward or backward through the display by pressing various navigation keys on the keyboard. The Page Up and Page Down keys will move the display backward or forward one page at a time. The Home key will jump to the first data acquired and the End key will take the display to the last data acquired. The number 5 key on the numeric keypad (make sure that the number lock indicator on the keyboard is off) will bring you back to the trigger point.

A special feature of the software is search capabilities. By pressing the S key, the search menu will

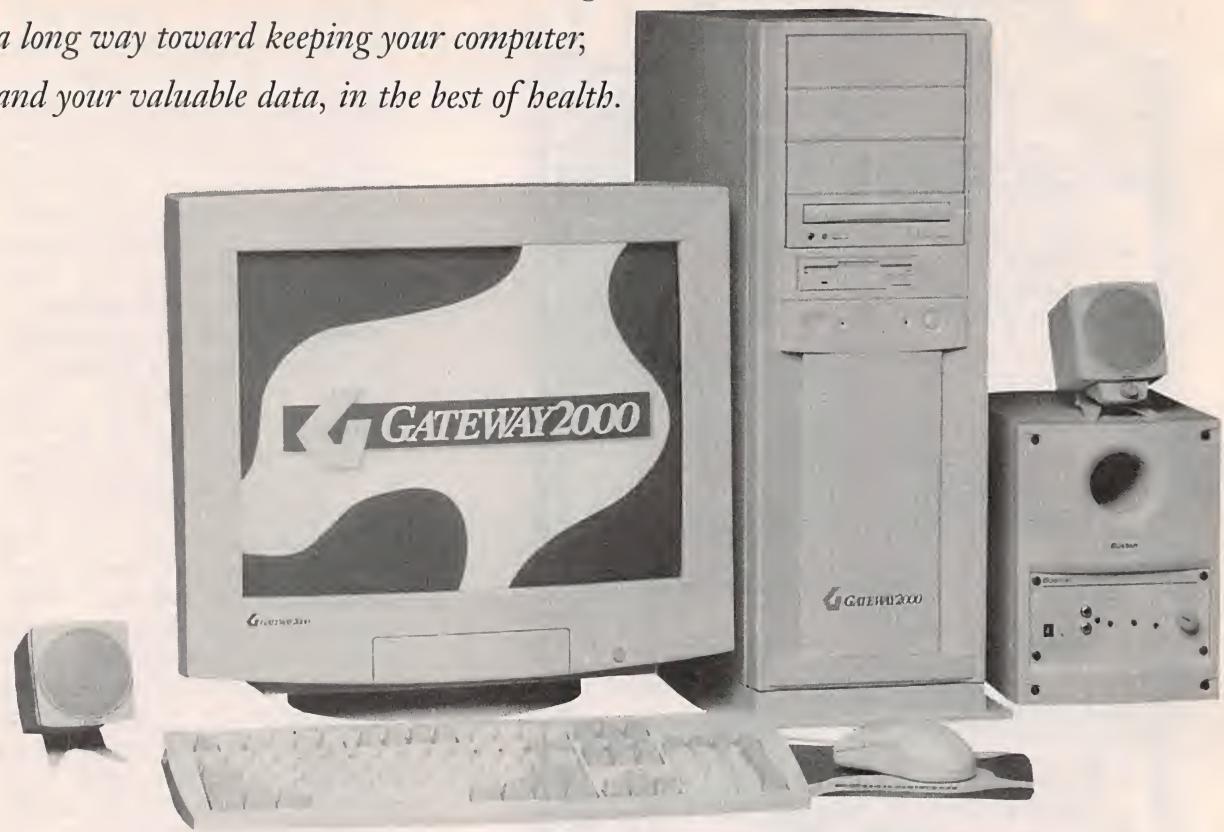
appear. Type in the data pattern you want to find. It is typed in the same way a trigger condition is set (1, 0, and X). After pressing the return key, select F for forward search or R for a reverse search. The program will search for data that matches the search pattern and display that location on the screen. Pattern searching is a very powerful feature because of the large amount of data in 2048 samples.

Press ESC to exit the state display. The timing display is entered by pressing F7. That display mode requires a CGA or better graphics card and monitor on the computer. The data will be displayed in timing-diagram format. A cursor is at the trigger point, and the state information from the cursor position is displayed at the top of the screen. The ESC, Page Up, Page Down, Home, End, numeric 5 key, and the search option work the same way as with the state display. In addition, the left and right arrow keys can move the cursor back and forth through the data to display the state information for any point. The data and setup information (trigger patterns, clock rate, etc.) can be stored and recalled by pressing F8. That will let you save any collected data and view it at another time.

In the sample we just took, the timing display should show that bits 1, 2, and 3 are always at logic zero. Bit 0 should alternate between 0 and 1 every 16 samples, which works out to 3.2 microseconds. At time 0 (the trigger point), bit 0 should be a logic one, which is what we assigned as the trigger. Using F3, change the trigger mode to be "A" then "B". Select a 10-MHz clock rate using F4. Use F5 to start a new data acquisition. When the new data samples are done, look at the timing display. It should show that bit 0 is now a logic zero at time 0. Bit 0 should be a logic one for 3.2 microseconds just before time 0. Since we doubled the sampling rate, 3.2 microseconds is 32 samples. With the trigger condition set to "A" followed by "B," the "A" trigger condition had to be met first, in which bit 0 is a 1. Once the first condition is met, the B trigger condition

(Continued on page 50)

*These simple maintenance procedures can go a long way toward keeping your computer, and your valuable data, in the best of health.*



## MAINTAINING YOUR OWN PC

For most of us, the purchase of a personal computer, or PC, is a substantial investment of both time and money. But after the money is spent and the PC is in our home or office, few PC users ever take the time to properly maintain their PC. That's unfortunate, as routine maintenance is an important part of PC ownership and can go a long way toward keeping your computer's hardware and software error-free. Proper routine maintenance, following the schedule outlined in Table 1, can also help to avoid costly visits to your local repair shop; in the U.S., labor alone can run \$50-\$70/hour. That's where this article comes in: In the pages that follow we will provide you with a comprehensive, step-by-step procedure for protecting and maintaining your personal-computer investment.

STEPHEN J. BIGELOW

ing to note that the data recorded on a computer's hard drive is often far more valuable than the drive itself. But if the drive fails, your precious data is usually lost along with the hardware. Months (perhaps years) of records and data could be irretrievably lost. It goes without saying then that one of the first steps in any routine maintenance plan is to make regular backups of your system's contents—as well as the system's configuration. Backups ensure that you can recover from any hardware glitch, accidental file erasure, or virus attack.

File backups are important for all types of PC users from major corporations to occasional home users. By creating a "copy" of your system files (or even just a part of them), you can restore the copy and continue working in the event

of a disaster. Before you proceed with any type of system checks, consider performing a file backup.

You're going to need two items in order to backup your files: a "backup drive" and backup software. The actual choice of backup drive is really quite open. Tape drives such as the Iomega Ditto drive ([www.iomega.com](http://www.iomega.com)) or the MicroSolutions 8000T 8GB "Backpack" drive ([www.micro-solutions.com](http://www.micro-solutions.com)) are the traditional choice, but other high-volume removable media drives like Iomega's 100MB Zip drive, their 1GB Jaz drive, or the SyQuest 1.5GB SyJet drive ([www.syquest.com](http://www.syquest.com)) are also very popular. Most drives are available in both internal and external configurations. One advantage of an external drive, particularly one that interfaces to your PC via its parallel port, is that it is portable—it can be shared between many PCs.

You'll also need some backup

software to format the media, and handle your backup and restore operations. If you're using Windows 95, try the native Backup applet (click on *Start, Programs, Accessories, System Tools, and Backup*). If Backup doesn't suit your needs, many drives ship with a backup utility on diskette. Just make sure that the backup drive and backup software are compatible with one another.

Backups generally fall into two categories: incremental and complete. Both types of backups offer unique advantages and disadvantages. An incremental backup only records the "differences" from the last backup. That usually results in a faster backup procedure and uses less tape (or other media), but restores take longer because you need to walk through each "increment" in order. A complete backup records the drive's full contents. That takes much longer and uses a lot more media, but restores are easier. Many PC users use a combination of complete and incremental backups. For example, you might start with a complete backup on January 1, then make incremental backups each week until the end of February. By March 1, you'd make another complete backup and start the incremental backup process again.

Perhaps the most overlooked issue with backups is the frequency—how often should backups be performed? The answer to that question is not always a simple one, because everyone's needs are different. Major corporations with busy order-entry systems may backup several times each day, while individual home users may not even consider backups to be necessary. The standard that I use is this: can you afford to lose the data on this drive? If the answer is "no," it's time to back up.

Regardless of how you choose to handle file backups, there are some tips that will help you get the most from your backup efforts:

- Keep the backup(s) in a secure location (such as a fire-proof safe or cabinet).
- Keep the backup(s) in a different location than the original PC.



High-volume removable media, like this SyQuest 1.5GB SyJet drive, can make the job of backing up your data easier.

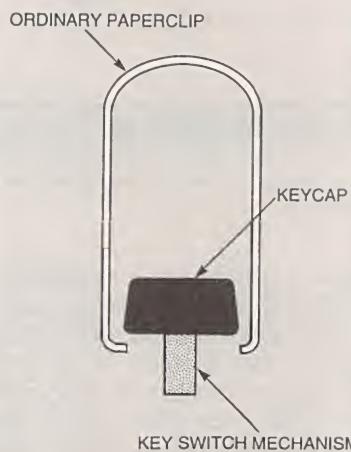


Fig. 1. To get at a sticky or unresponsive key switch, you can use an ordinary paper clip, bent as shown, to remove the keycap.

- Back up consistently—backups are useless if they are out of date.
- If time is a factor, start with a complete backup, and then use incremental backups.
- Use a parallel port tape drive (or other "backup" drive) for maximum portability between PCs.

**CMOS Backups.** All PCs use a sophisticated set of configuration settings (everything from "Date" and "Time" to "Video Palette Snoop" and "Memory Hole") that defines how the system should be operated. Those settings are stored in a small amount of very low power memory called CMOS RAM. Each time the PC starts, motherboard BIOS reads the CMOS RAM, and copies the contents into low system memory (the BIOS Data Area). While system power is off, CMOS RAM contents are maintained with a small battery. If that battery goes dead, CMOS contents can be lost. In most cases, that will prevent the system from even starting until you reconfigure the CMOS setup from scratch. By

making a backup of the CMOS setup, you can restore lost settings in a matter of minutes. CMOS backups are simply printed screens of your CMOS setup pages.

From the above, it is obvious that the one item that you'll need to perform a CMOS backup is a printer—it really doesn't matter what kind of printer (i.e. dot-matrix, ink jet, or laser). The printer should be attached to the PC's parallel port. After starting the CMOS setup routine, visit each page of the setup, and use the *<Print Screen>* key to "capture" each page to the printer. Since every BIOS is written differently, be sure to check for sub-menus that might be buried under each main menu option.

CMOS backups are quick and simple, but you'll get the most benefit from a CMOS backup by following these pointers:

- Make it a point to print out every CMOS Setup page.
- Keep the printed pages taped to the PC's housing or with the system's original documentation.
- You should back up the CMOS setup whenever you make a change to the system's configuration.

**Cleaning.** Now that you've backed up the system's vital information, you can proceed with the actual maintenance procedures. The first set of procedures involves exterior cleaning. That hardly sounds like a glamorous process, but you'd be surprised how quickly dust, pet hair, and other debris can accumulate around a computer. You'll need four items for cleaning: a supply of Windex or another mild ammonia-based cleaner (a little ammonia in water will work just as well), a supply of paper towels or clean lint-free cloths, a canister of electronics-grade compressed air (which can be obtained from any electronics store), and a small static-safe vacuum cleaner.

**Note:** Avoid the use of ordinary household vacuum cleaners. The rush of air tends to generate significant amounts of static electricity along plastic hoses and tubes, which can accidentally damage the sensitive electronics in a PC. Also, never

use harsh or industrial-grade cleaners around a PC. Harsh cleaners often contain chemicals that could damage the finish of (or even melt) the plastics used in PC housings. Use a highly diluted ammonia solution only.

As a rule, exterior cleaning should be performed every four months (three times per year) or as required. If the PC is operating in dusty, industrial, or other adverse environments, you may need to clean the system more frequently. Systems operating in clean office environments may only need to be cleaned once or twice each year. Always remember to turn off the computer, and unplug the AC cord from the wall outlet before cleaning.

To clean the case, use a clean cloth lightly dampened with ammonia cleaner to remove dust, dirt, or stains from the exterior of the PC. Start at the top and work down. Add a little bit of extra cleaner to remove stubborn stains. You'll find that the housing base is typically the dirtiest (especially for tower systems). When cleaning, be careful not to accidentally alter the CD-ROM volume or sound-card master-volume controls. Also do not dislodge any cables or connectors behind the PC.

**Note:** Always dampen a clean towel with cleaner—never spray cleaner directly onto any part of the computer.

While cleaning the case, pay particular attention to the air intake(s), usually located in the front (or front sides) of the housing. Check for accumulations of dust or debris around the intakes or caught in an intake filter. Clean away any accumulations from the intake area, and then use your static-safe vacuum to clean the intake filter if possible—you might need to remove the intake filter for better access. If the intake filter is washable, you might choose to rinse the filter in simple soap and water for the best cleaning (remember to dry the filter thoroughly before replacing it). Of course, if there is no intake filter, simply clean around the intake area.

Multimedia speakers offer a countless number of ridges and openings that are just perfect for accumulating dust and debris. Use your can of compressed air to gen-

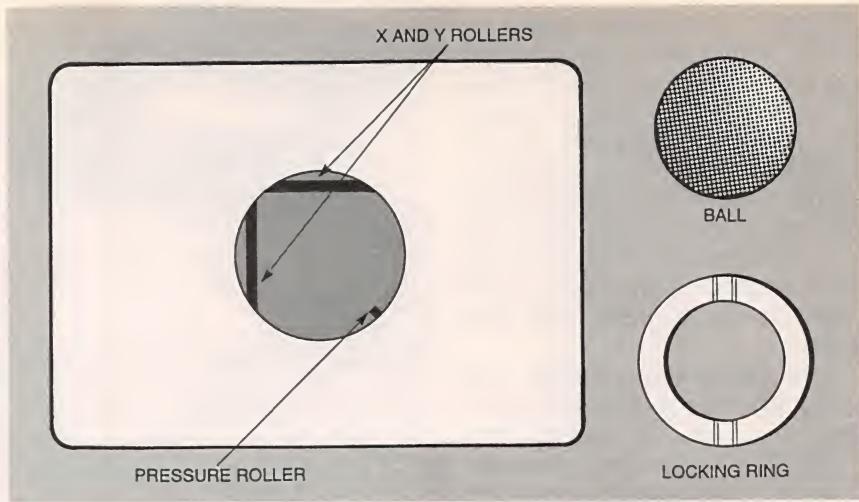


Fig. 2. An important part of cleaning a mouse is to make sure the internal rollers are free of dirt and grime build up.

tly blow out the speaker's openings. Do not insert the long, thin air nozzle into the speaker—you can easily puncture the speaker cone and ruin it. Instead, remove the long nozzle and spray air directly from the can. Afterward, use a clean cloth lightly dampened with ammonia solution to remove any dirt or stains from the speaker housings.

Keyboards are open to the environment, so dust and debris readily settle between the keys. Over time, those accumulations can jam keys or cause repeated keystrokes. Attach the long thin nozzle to your can of compressed air, and use the air to blow through the horizontal gaps between key rows. Be careful—this will kick up a lot of dust—so keep the keyboard away from your face. Afterward, use a clean cloth lightly dampened with ammonia solution to remove dirt or stains from the keys and keyboard housing. If any keys seem unresponsive or "sticky," you can remove the corresponding keycap (see Fig. 1) and spray a bit of good-quality elec-

tronic contact cleaner into the key assembly; then gently replace the keycap.

**Note:** Do not remove the <Enter> key or <Space Bar>. Those keys are held in place by metal brackets that are extremely difficult to re-attach once the key is removed. Only the most experienced technicians should work with these keys.

There are several important areas to deal with when cleaning a monitor: ventilation, case, and CRT. Monitors rely on vent openings for proper cooling. Use your vacuum cleaner, and carefully remove any accumulations of dust and debris from the vents underneath the case, as well as those on top of the case. Make sure that none of the vent openings are blocked by paper or other objects (that can restrict ventilation and force the monitor to run hot).

Next, use a clean cloth lightly dampened with ammonia solution to clean the monitor's plastic case. There is active circuitry directly under the top vents, so under no circumstances should you spray cleaner directly onto the monitor housings. Do not use ammonia or any chemicals to clean the CRT face. The CRT is often treated with anti-glare and other coatings, and even mild chemicals can react with some coatings. Instead, use clean tap water only to clean the CRT face. Be sure to dry the CRT face completely.

Like the keyboard, a mouse is particularly susceptible to dust and

#### ABOUT THE AUTHOR

Stephen J. Bigelow is the author of *Troubleshooting, Maintaining, and Repairing Personal Computers: A Technician's Guide* (published by McGraw-Hill). He can be reached by e-mail at: [sbigelow@cerfnet.com](mailto:sbigelow@cerfnet.com). You may also visit the Dynamic Learning Systems Web site at: [www.dlspubs.com](http://www.dlspubs.com). Comments and questions about this article are welcome at any time.

debris, which are carried from the mouse pad up into the mouse ball and rollers. When enough foreign matter has accumulated, you'll find that the mouse cursor hesitates or refuses to move completely. Loosen the retaining ring and remove the mouse ball. Clean the mouse ball using a clean cloth and an ammonia solution. Dry the mouse ball thoroughly, and set it aside with the retaining ring. Next, locate three rollers inside the mouse (an "X" roller, a "Y" roller, and a small "pressure" roller as shown in Fig. 2). Use a clean cloth dampened with ammonia solution to clean all of the rollers completely. Use your can of compressed air to blow out any remaining dust or debris that may still be inside the mouse. Finally, replace the mouse ball, and secure it into place with its retaining ring.

#### Checking Cables and Connections.

Now that the system is clean, it's time to perform a few practical checks of the system interconnections. There are a myriad of external cables interconnecting the computer to its peripheral devices. You should examine each cable and verify that it is securely connected. If the cable can be secured to its connector with screws, make sure that the cable is secured properly. As a minimum, check the following cables:

- AC power cable for the PC
- AC power cable for the monitor
- AC power cable for the printer
- AC/DC power pack for an external modem (if used)
- Keyboard cable
- Mouse cable
- Joystick cable (if used)
- Video cable to the monitor
- Speaker cable(s) from the sound board
- Microphone cable to the sound board (if used)
- Serial-port cable to external modem (if used)
- Parallel-port cable to printer
- RJ11 telephone-line cable to internal or external modem (if used)

**Cleaning Drives.** In spite of their age, floppy disks remain a reliable and highly-standardized media, and

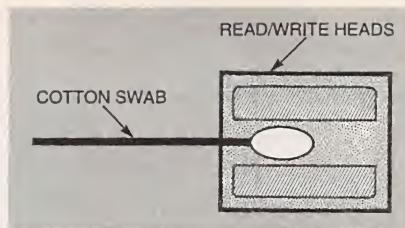


Fig. 3. If you don't have a drive-cleaning kit, use an electronics-grade swab dampened with isopropyl alcohol to scrub between the read/write heads. Note that the view here is looking into the floppy door.

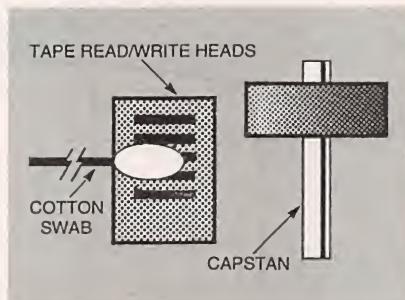


Fig. 4. You can also use an isopropyl-alcohol-dampened swab to clean the tape heads and capstan in a tape drive. Again, this view is looking into the drive from the tape door.

every new PC sold today still carries a 3.5-inch 1.44MB floppy drive. However, floppy disks are a "contact" media—the read/write heads of the floppy drive actually come into contact with the floppy disk. That contact transfers some of the magnetic oxides from the floppy disk to the drive's read/write heads. Eventually, enough oxides can accumulate on the read/write heads to cause reading or writing problems with the floppy drive. You should periodically clean the floppy drive to remove any excess oxides.

Cleaning can be accomplished in several ways: you can use a pre-packaged "cleaning kit", or swab the read/write heads with fresh isopropyl alcohol. You can obtain pre-packaged cleaning kits from almost any store with a computer or consumer-electronics department. With a cleaning kit, you simply dampen a mildly abrasive "cleaning diskette" with cleaning solution (typically alcohol-based), and then run the cleaning diskette in the drive for 15-30 seconds. You can often get 10 to 20 cleanings from a cleaning diskette before discarding it.

If you don't have a cleaning kit handy, you can use a long, thin, electronics-grade fabric swab

dampened in fresh isopropyl alcohol, and gently scrub between the read/write heads (see Fig. 3). Remember to turn off and unplug the PC before attempting a manual cleaning. Repeat the scrubbing with several fresh swabs, and then use a dry swab to gently dry the heads. Allow several minutes for any residual alcohol to dry before turning the PC back on.

As with floppy drives, tape drives are also a "contact" media, and the tape head is in constant contact with the moving tape. That causes oxides from the tape to transfer to the tape head and capstans, and that can ultimately result in reading or writing errors from the tape drive. If a tape drive is present with your system, you should periodically clean the tape head(s) and capstans to remove any dust and excess oxides. You might be able to find a pre-packaged drive cleaning kit for your particular tape drive. Otherwise, you'll need to clean the tape drive manually.

Turn off and unplug the PC. As with the floppy drive, use an electronics-grade swab dampened in fresh isopropyl alcohol to gently scrub the tape head(s) and capstan (see Fig. 4). Repeat the scrubbing with several fresh swabs, then use a dry swab to gently dry the tape head(s). Allow several minutes for any residual alcohol to dry before turning the computer back on.

**Miscellaneous Checks.** Most CD-ROM drives operate using a "tray" to hold the CD. Try ejecting and closing the tray several times—make sure that the motion is smooth, and that there is no hesitation or grinding that might suggest a problem with the drive mechanism. While the tray is open, check for any accumulations of dust, pet hair, or other debris in the tray that might interfere with a CD. Clean the tray with a cloth lightly dampened in water (only). Be sure that the tray is completely dry before closing it again. Do not use ammonia or ammonia-based cleaners around the CD-ROM—prolonged exposure to ammonia vapors could damage a CD.

Next, you should make sure that your sound system is set properly.

Begin by playing an ordinary audio CD in the CD-ROM drive. Check the sound board itself, and locate the master volume control (not all sound boards have a physical volume knob). Make sure that the master volume is set at 75% or higher. If not, you might need to keep the speaker volume abnormally high, and that can result in a hum or other noise in the speakers. If the sound board does not have a master volume control, check the board's "mixer" applet (see Fig. 5), and see that the master volume is set properly. Once the sound board is set, you can adjust the speaker volume to achieve the best sound quality.

**Note:** Speakers are magnetic devices that can interfere with the color purity of a monitor. Keep unshielded speakers at least 6 inches away from your monitor.

Here's more on that topic: Color monitors use a fine metal screen located just behind the CRT face in order to isolate the individual color pixels in the display. That ensures that stray electrons don't strike adjacent phosphors and cause incorrect colors. If part or all of that metal screen becomes magnetized, it will deflect the electron beams and cause color distortion. Normally, a color CRT is demagnetized (or "degaussed") each time the monitor is turned on. That is accomplished through a "degaussing coil" located around the perimeter of the CRT face. However, if the CRT is subjected to external magnetic fields (such as unshielded speakers, motors, or other strong magnets), it may cause color problems across the entire CRT or in small localized areas as shown in Fig. 6.

Check the CRT for color purity by displaying an image of a known color (preferably white). Examine the image for discoloration or discolored areas. For example, if you display an image that you know is white, and it appears bluish (or there are bluish patches), chances are that you've got color purity problems.

There are three ways to correct color-purity problems. First, try moving anything that might be magnetic (such as speakers) away from the monitor. Second, try degaussing the monitor by turning it off, waiting



Fig. 5. If the sound board does not have a master volume control, check the board's "mixer" applet and make sure that the master volume is set properly.

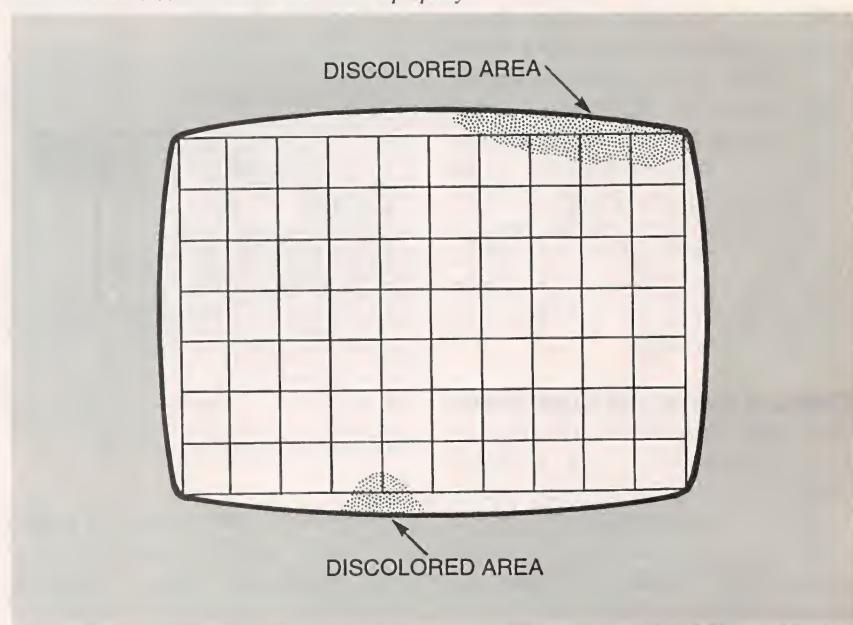


Fig. 6. Color purity problems, which are often caused by external magnetic fields like those generated by improperly shielded speakers, show up as discolored areas.

30 seconds, and then turning it on again. That allows the monitor's built-in degaussing coil to cycle. If the problem persists, wait 20-30 minutes and try cycling the monitor again. Finally, if the image is still discolored, you should take the monitor to a technician who can use a hand-held degaussing coil.

**Internal Checks.** At this point, we can move into the PC itself and perform some internal checks to verify that critical parts and cables are secure and that all cooling systems are working. Internal checks should usually be performed every six months (twice per year). Gather a small Philips screwdriver and an anti-static wrist strap. Use your screwdriver to unbolt the outer cover. Remove the outer cover (careful for sharp edges), and set it aside. Attach the wrist strap from your wrist to a good earth ground; that allows you to work safely inside the PC without the risk of acciden-

tal damage from electrostatic discharge (or ESD).

If you don't have a wrist strap, here's what and what not to do: Avoid wearing clothes made of synthetic materials or silk; cotton or cotton-blend clothing is better. Also, do not wear rubber-soled shoes. Keep some part of your skin in good contact with the PC's bare-metal frame, both before and while you are working inside the machine; that keeps both you and the circuitry (especially the \$500 CPU) at the same electrical potential. The best way to meet that last requirement is to either grab the frame with one hand as you work or to roll up your sleeve and lean on the frame with your forearm.

PCs tend to generate a substantial amount of heat during normal operation, and that heat must be ventilated with fans. If one or more fans fail, excess heat can build up in the PC enclosure and result in system crashes or premature system

TABLE 1—PC MAINTENANCE SCHEDULE

Procedure	Frequency
<i>File Backup</i>	Whenever important data cannot be recreated Order Entry—daily Business/Art/Multimedia—weekly SOHO/Accounting—bi-weekly or monthly Home Use—every several months
<i>CMOS Backup</i>	Whenever changes are made to the system's configuration
<i>Cleaning</i>	Every 4 months, or as required Vacuum-clear accumulations of dust and debris as required
<i>External Check</i>	Every 4 months
<i>CRT Degauss</i>	Only if necessary
<i>Internal Check</i>	Every 6 months
<i>Drive Check</i>	Monthly, or when major files are added/deleted from the system
<i>Boot Disk</i>	Update disk whenever hardware changes are made to the system

failures. Now that the cover is off, your first check should be to see that all the fans are running. As a minimum, check the power-supply fan, the case-exhaust fan (both usually located at the rear of the enclosure), and the CPU heat sink/fan. Some PCs, such as those housed in full-sized tower enclosures, could sport even more fans. If any fans are not running, they should be replaced—or the system should be serviced by an experienced technician who can replace defective fans.

Pay particular attention to the CPU heat sink/fan. Virtually all Intel Pentium/Pentium MMX/Pentium II, AMD K5/K6, and Cyrix 6x86/M2 CPUs are fitted with a heat sink/fan. That fan *must* be running, or the CPU runs a very real risk of overheating and failing. If you notice that the fan has stopped, you should have the heat sink/fan assembly replaced as soon as possible.

Now for the cleaning: Turn off and unplug the PC, and then examine the fans and exhaust filters for accumulations of dust or other debris. Use your static-safe vacuum to clean the fan blades. Clean

away any accumulations from the exhaust area, and then clean the exhaust filter if possible—you may need to remove the exhaust filter for better access. If the exhaust filter is washable, you may choose to rinse the filter in simple soap and water for best cleaning (remember to dry the filter thoroughly before replacing it). Of course, if there is no exhaust filter, simply clean around the exhaust area. Also vacuum away any other accumulations of dust that you might find on the motherboard or around the drives, but be very careful to avoid vacuuming up the little jumpers on the motherboard!

**Note:** Remember that PC electronics are *extremely* sensitive to ESD (electrostatic discharge), so make sure to use a static-safe vacuum inside the PC.

Most PCs use several expansion boards that are plugged into expansion slots on the motherboard. Internal modems, video boards, SCSI adapters, and network cards are just a few types of expansion boards. Each expansion board must be inserted completely into its corresponding slot, and the metal mount-

ing bracket on the board should be secured to the chassis with a single screw. Make sure that every board is installed evenly and completely, and see that the mounting bolts are good and tight.

You'll notice that there are a large number of cables inside the PC. Each cable must be installed securely—especially the wide ribbon cable connectors that can easily be tugged off. Take a moment to check any wiring between the case and the motherboard such as the keyboard connector, power LED, on/off switch, drive activity LED, turbo switch, turbo LED, and so on. Next, check the following cables:

- Motherboard power connector(s)
- All four-pin drive-power cables
- Floppy-drive ribbon cable
- Hard-drive ribbon cable
- CD-ROM ribbon cable (usually separate from the hard-drive cable)
- CD four-wire audio cable (between the CD-ROM and sound board)
- SCSI ribbon cable (if used)
- SCSI terminating resistors (if used)

Memory is most often provided in the form of SIMMs (single in-line memory modules), which simply clip into sockets on the motherboard. Loose SIMMs can cause serious startup problems for the PC. Examine each SIMM—verify that they are inserted properly into each socket and that both ends of each SIMM are clipped into place. Some newer PCs use DIMMs (dual in-line memory modules) instead of SIMMs; those should also be checked as outlined above.

The CPU is the single largest IC on the motherboard and it is usually installed into a ZIF (zero insertion force) socket for easy replacement or upgrade. Examine the CPU, and see that it is inserted evenly into its socket. The ZIF socket lever should be in the "closed" position and locked down at the socket itself. Check the placement of the CPU's heat sink/fan next—it should sit flush against the top of the CPU. It should not slide around or be loose. If it is, the heat sink/fan should be secured

or replaced.

The final step in your Internal check should be to inspect the drive mountings. Each drive should be mounted in place with four screws—the use of fewer screws could allow excessive vibration in the drive, which could lead to premature failure. Make sure that each drive has four mounting screws, and use your Philips screwdriver to tighten each bolt.

**Note:** Do not overtighten the bolts. That can actually warp the drive frame and cause errors or drive failure.

**Checking the Hard Drive.** After the PC has been cleaned and checked inside and out, it's time to test the hard drive for potential problems. That involves checking the drive's file system, reorganizing files, and creating an updated boot disk. To perform a drive check, you'll need a copy of ScanDisk and Defrag. For those using Windows 95, those utilities are already built into the operating system so you can reboot the PC and use those utilities directly. If you are not running Windows 95 or are more comfortable with running those utilities from DOS, create a "startup disk" (more on that in a moment) and boot from that; then run ScanDisk and Defrag right from the startup disk. As a rule, you should perform the drive check very regularly—once a month is usually recommended; or whenever you make major additions or deletions from your system.

Your PC should always have a boot disk that can start the system from a floppy drive in the event of an emergency. Windows 95 has the ability to create a "startup disk" automatically. If you have access to a Windows 95 system, use the following procedure to create a DOS 7.x startup disk:

- Label a blank diskette, and insert it into your floppy drive.
- Click on *Start, Settings, and Control Panel.*
- Double-click on the *Add/Remove Programs* icon.
- Select the *Startup Disk* tab.
- Click on *Create Disk.*
- The utility will remind you to insert a diskette, then prepare

the disk automatically. When the preparation is complete, test the diskette.

The preparation process takes several minutes, and will copy the following files to your diskette: ATTRIB, CHKDSK, COMMAND, DEBUG, DRVSPACE.BIN, EDIT, FDISK, FORMAT, REGEDIT, SCANDISK, SYS, and UNINSTAL. All of these files are DOS 7.x-based files, so you can run them from the DOS A: prompt.

The ScanDisk utility is designed to check your drive for file problems (such as lost or cross-linked clusters) and then correct those problems. If you're running from the startup disk, start ScanDisk by typing:

A:\> scandisk<Enter>

If you're running from Windows 95, click *Start, Programs, Accessories, System Tools, and ScanDisk*. Select the drive to be tested, and start the test cycle. ScanDisk will report any problems and give you the option of repairing the problems.

Operating systems like DOS and Windows 95 segregate drive space into groups of sectors called "clusters." Clusters are used on an "as found" basis, so it is possible for the clusters that compose a file to be scattered across a drive. That forces the drive to work harder (and take longer) to read or write the complete file because a lot of time is wasted moving around the drive. The Defrag utility allows file clusters to be relocated together. If you're running from the Startup Disk, start Defrag by typing:

A:\> defrag<Enter>

If you're running from Windows 95, click *Start, Programs, Accessories, System Tools, and Disk Defragmenter*. Select the drive to be tested, and start the cycle. Defrag will relocate every file on the disk so that all their clusters are together.

**Note:** You can run Defrag any time, but you do not need to run Defrag until your disk is more than 10% fragmented.

**Conclusion.** That concludes the maintenance procedure for your PC. Now you can replace the outer

cover and bolt it back into place (be careful of sharp edges). After the enclosure is secure, reboot the system and perform a final test of some of the major applications—the system should perform exactly the same as it did before. By performing this routine maintenance, you can keep your PC running longer and save on expensive down-time or trips to the shop.  $\Omega$

## LOGIC ANALYZER

(continued from page 43)

had to be met (with bit 0 at 0).

Experiment with the different clock rates, trigger modes, and trigger values. Also be sure to use all of the probes on signal Q7 in order to verify that all of the channels on the analyzer are working. One final note concerning the "A" then "B" trigger mode: only the lower 4 bits (0-3) of each trigger value are valid. Once you have tried all the options, you are ready to use the logic analyzer on other circuits.

A logic analyzer is a very valuable tool for working with digital logic. It can be used to verify timing relationships or for troubleshooting digital logic. The author welcomes any questions, comments, or suggestions on this project. He can be contacted by e-mail at [alta@gutbang.com](mailto:alta@gutbang.com), by telephone at (860) 489-8003, or by visiting the Alta Engineering Web site at [www.gutbang.com/alta](http://www.gutbang.com/alta).

## Timid about getting on the... World Wide Web?

You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, *The Internet and World Wide Web Explained*, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #403 send \$6.95 plus \$3.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

In the first part of this series (*Electronics Now*, February 1998) we explored some of the issues you should consider before beginning the repair or restoration of a vintage open-reel tape recorder. This month, we'll begin the actual restoration process. While we can't begin to cover each of the thousands of makes and models individually, the procedures we present are generally applicable to almost all machines. Where fundamental differences exist—such as tube vs. transistor or single-motor vs. three-motor designs, we'll point out any different approaches that might be necessary.

But before we get too much further, there are a few things we need to warn you about:

- Electricity can be dangerous. Do not attempt any electrical inspection or repair if you do not have the necessary general knowledge, experience, and tools. While low-voltage, battery-operated, all-transistor equipment, like the unit pictured in Fig. 1, might be relatively safe, anything with vacuum tubes, high-voltage batteries, or AC-line cords should be considered dangerous—with potentially lethal consequences.

- Mechanical inspection, troubleshooting, repair, and restoration attempts can also be dangerous. Many people have sustained permanent injury as a result of improper mechanical technique. Clothing and fingers get caught, eyes get hit with various projectiles, etc. Don't let that happen to you! Do not attempt any mechanical work if you do not have the necessary knowledge, experience, and tools.

- Never, ever succumb to the temptation of plugging in your newly-acquired vintage recorder "just to see if it works," if it has not been used for months or years and has not gone through the preliminary restoration steps described below. In short, doing so is just about

# RESTORING A "REEL" RECORDER



*This month we take  
the first steps towards  
bringing our "golden oldie"  
back to its original splendor*

PHIL VAN PRAAG

the worst thing you could do! Okay, maybe not the worst thing; after all, you could bounce it down a flight of 30 concrete steps or use it as a boat anchor on your next ocean fishing trip! But, seriously, plugging in a tape recorder without first doing the necessary work could irreparably damage electrolytic capacitors, permanently bend or break "frozen" brake bands, cause totally unnecessary bearing wear, destroy what may still be some potential life in drive belts, or jam/seize-up mechanical levers, pulleys, or shafts.

On a different but related subject, as with any repair or restoration job, it is important to keep scrupulous notes. Don't rely on memory—write down every abnormality or questionable area you find as you go through the recorder. You may be amazed at the number of observations you have recorded by the time you are finished. Those notes, together with details of actual repairs, should become a permanent log for this particular machine, and it will be an invaluable future reference.

**Initial Preparations.** Before you begin, prepare your work area with the appropriate tools, lighting, cleaning stuff, lubricating stuff, a magnifying glass, a pencil and paper, and a "Varilac" (variable-voltage AC transformer). The cleaners I use are: "Fantastik," any mild glass cleaner, isopropyl (rubbing) alcohol, "Endust," a good quality spray "tuner cleaner" (such as GC Electronics 19-634), and mineral spirits. (For brevity, I have not included any wood-working or wood-cleaning considerations here.) You will also want to have a supply of paper towels and "Q-tips" handy, along with inexpensive 1/2- and 1-inch soft paint brushes.

Lubricants should include both oil and grease. The oil, for everything other than motors, should be a light machine oil housed in a small plastic vial—preferably with a telescopic-style nozzle. For motors, use a quality 20-weight motor oil. For very light grease applications, where no significant heat is present, "Vaseline" works remarkably well. For average or heavy-duty use, automotive-suspension grease will do the job.

**Exterior Cleaning.** The first step is to thoroughly clean and inspect all exterior surfaces of the recorder, beginning with the tape path. The tape path (see Fig. 2) must be meticulously cleaned from the first

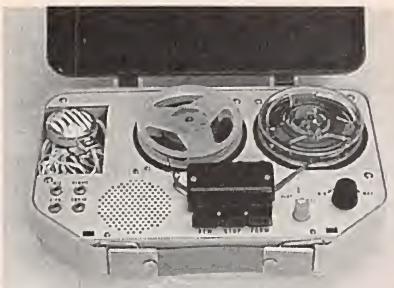


Fig. 1. A small, battery-operated tape recorder like this one might not produce dangerous internal voltages, but be very careful when working with AC-powered units as high, or even lethal, voltages could be present inside.

point of tape contact beyond the supply reel to the final point of tape contact, which is just ahead of the take-up reel. Every nook and cranny must be spotless. That includes all edges and corners of tape guides, posts, and heads. Use only isopropyl alcohol and Q-tips for this task. Never use abrasives of any kind; and, whatever you do, resist the temptation to scrape those guide edges with a small screwdriver. You will scratch the metal and forever cause abrasion against the tape (which not only wears out the tape, but also makes future oxide build-up an even greater problem).

I must confess I've been guilty of using my fingernails on occasion, or even breaking off a Q-tip end and using the paper Q-tip shaft, but that's the limit. This job might seem

to take forever; it may appear as if the tape oxide has been deviously epoxied to the metal. That is normal; just keep at it. One other word of warning here: Don't use excessive force during the cleaning process. Heads can be pushed out of alignment and tape guides can be bent if you are not careful. Also, as you go through the cleaning process, be sure to note any abnormality or questionable area such as an apparently scratched head, a bent tape-guide lever, or potentially excessive wear.

By the way, it's okay to use isopropyl alcohol on the pinch roller. This roller is typically located to the right of the tape heads, as pictured in Fig. 3, though it might also be centered within the head assembly. Such a setup is occasionally found on auto-reversing machines. Also, a small number of models contained two pinch rollers, one on each side of the head assembly. Regardless of the setup, the cleaning procedure is basically the same: Simply hold the roller stationary with one hand, and clean the tape contact surface with the other using an alcohol-moistened paper towel.

Note: Do not attempt to clean the pinch roller when the machine is running—with the roller engaged against the capstan shaft—as this can be dangerous. I have never found Isopropyl alcohol to damage

the rubber (even after many applications over many years) if used only as the roller is being wiped clean.

Next, thoroughly clean the remaining front-panel area, using glass cleaner if it's only dusty, or a stronger cleaner (such as Fantastik) if it's dirty. As you do this, be careful not to wipe off old lettering. Mineral spirits is handy for removing household-tape adhesive remnants. Note that Fantastik sometimes leaves a film residue; that can be removed with an application of glass cleaner. Then clean the rear panel and/or compartment area. Take note of any broken connectors, frayed cables, missing "remote" plugs, etc. Now finish cleaning the remainder of the exterior cabinet.

As a last step, go back and take one more careful look at the tape path, using the magnifying glass this time to note any imperfections or oxide clumps you might have missed the first time. Also "sight down" the heads and guides to take note of any gross misalignments. By sighting down, I mean get your head down to the tape path area to gain a view similar to that shown in Fig. 4. Close one eye and visually bring adjacent tape contact points into view—carefully watching to see that surfaces are parallel or perpendicular where they should be. Don't bend or otherwise adjust anything at this time.

**General Interior Cleaning.** Now let's tackle the interior cleaning and inspection. The goal of this step is to determine the overall state of the "internals" and perform some minor cleaning and lubrication in an attempt to condition the machine to the point where it can be safely powered up. It's only after power application that you will be able to determine, in detail, the extent of work needed to complete the restoration.

At this point, remove enough of the cabinetry to gain access to the major mechanical and electronic sections. Make sure you keep track of the disassembly sequence and all of the hardware you remove in the process. Using Endust or something similar sprayed onto a paint brush (just a little will do nicely), carefully brush out the interior—

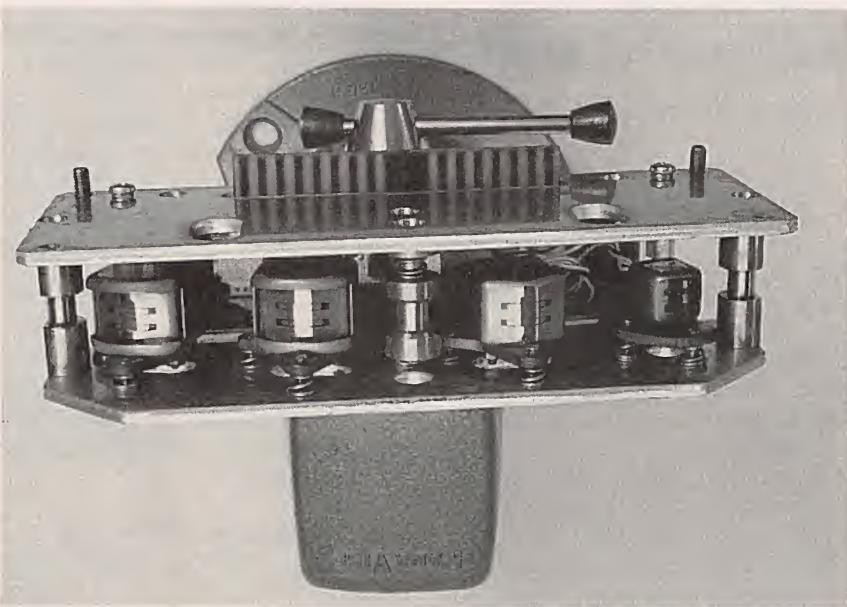


Fig. 2. The various tape heads and guides found in the tape path of a typical audio-tape recorder. This particular head assembly is from an auto-reverse machine. It contains four heads: one each for 52

# The Four-Year Electronics Degree Program That Really Hits Home!

**Bring The Technology Home With A Bachelor Of Electronics Engineering Degree. No Hassles. No High Cost!**



Now's the time to prepare for a profitable career.

## We've lowered the cost of higher education.

It's true! You can earn a four-year Bachelor of Electronics Engineering Technology degree today ... and prepare yourself for a high-paying electronics career ... without quitting your job or ever leaving your home. Because World College, an affiliate of the Cleveland Institute of Electronics, offers you the total flexibility of independent study programs proven effective for people like you who truly want to succeed! World College independent study lessons help you build valuable skills

**Mail/Fax Today or Call  
1-800-696-7532**

step-by-step, and expert instructors are personally available to you with a toll-free call. What a way to earn an education!

## A world of opportunity.

Where is your career headed? With a four-year bachelor's degree from World College, you call the shots, choosing from incredible, high-paying opportunities in electronics, telecommunications, computer, electrical power, and many other growing fields.

World College gives you the skills, the knowledge, the power to take advantage of your best opportunity in electronics. And you can do it all at your own pace!

## Without leaving home.

World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

All the equipment, parts, and software you need are included in your affordable tuition, including more than 300 hands-on lab experiments you can complete in your home.

## Choose your own pace.

Earn your bachelor's degree on your time — and at your pace — because you pay tuition to World College only as you complete the upper-level semesters close to graduation. The faster you make it through, the less you pay. So you have an incentive to make your future happen quickly — yet the freedom to choose your own pace!

Send today for your FREE course catalog — and give yourself that future you've always wanted — with an electronics degree education from World College.



Take charge of your future in electronics.

## Four Powerful Reasons To Connect With World College Today:

1. **Earn your four-year degree!**
2. **Self-paced training!**
3. **Independent study in your home!**
4. **Expert instruction!**

## Give Me The Power!

Send me a FREE World College course catalog today!



(Please Print Neatly)

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State, Zip \_\_\_\_\_

Phone (\_\_\_\_\_) \_\_\_\_\_

Age \_\_\_\_\_

**For faster service, call  
1-800-696-7532,  
or call  
1-804-464-4600.**

**Or fax this coupon to  
1-804-464-3687.**



**WORLD  
COLLEGE**

Lake Shores Plaza  
5193 Drive, Suite 113  
Virginia Beach, VA 23455-2500



Affiliated with  
Cleveland Institute of Electronics  
WAE62



Fig. 3. In a typical type path, the pinch roller is located to the right of the tape heads, as shown here, though it might also be centered within the head assembly.



Fig. 4. One preliminary step when checking head alignment is to "sight down" the tape path as an initial check to ensure all tape contact surfaces are parallel to each other.

removing major clumps of dust and grit. Be very careful of the following as you do this:

- Do not dislodge or otherwise stress wires or components; transistors, for example, are often plugged in (as opposed to being soldered in place). If you brush too hard, you may inadvertently dislodge them.
- Do not brush areas containing grease; use Q-tips for those areas.
- Do not brush "into" mechanical components; doing so might cause dirt clumps to become lodged inside bearing surfaces.

A small vacuum cleaner could also be used here, but it would be most effective if used together with the brush. You might as well clean the inside of the cabinet as long as it's removed at this time.

Follow this with Fantastik-dampened paper towels to finish the

cleanup task. Once again, be careful to observe the above warnings. The idea here is not to produce a "spit shine" but rather to do a general cleaning, removing dust and dirt that otherwise might find its way into the moving parts, to create a reasonably clean "work area" for the subsequent detailed restoration tasks, and as part of the general discovery/inspection process. After all, you can't inspect it if you can't see it!

**Detailed Interior Cleaning.** Once you are satisfied that the general interior cleaning is adequate, the next step is detail cleaning. Use Q-tips and paper towels, moistened with isopropyl alcohol, to clean all rubber idlers and belts, the metal surfaces those rubber parts contact, and any other metal or plastic areas too small to cover with the previous cleanup. The locations of some of those components within a typical vintage recorder is shown in Fig. 5. Note that, particularly on machines from the 1950s, you might encounter cloth belts. Those belts were tensioned via a spring-loaded intermediate pulley. Remarkably, many of those belts are still serviceable today! If your machine has one of them, do not attempt to clean it with Isopropyl alcohol. In fact, don't get it wet at all.

Also, be very careful if you encounter any felt contact areas. Most likely that would be in the form of brake-band linings (if you have a three-motor machine), pressure

pads in the tape-path area, or turntable "slip-clutch" pads. Do not get the felt wet; in fact, don't attempt to clean the felt or touch it at all. Rather, just inspect it—and make a note if it appears to have significantly disintegrated over time.

If the machine has brake bands, you'll most likely have to remove them in order to clean the mating contact surfaces. The bands may have one fixed end and one pivoting end, which is spring loaded. Often by very carefully removing the pivoting end (noting all points of attachment), the band can be gently folded back enough to allow you to clean thoroughly. Those mating surfaces must be absolutely spotless—no dirt, no adhesive residue, nothing! Be extremely careful not to crease the metal bands—it will not be possible to completely remove the crease, and that could cause rubbing.

**Transport Lubrication.** The next part of the detail cleaning gets into areas that require a greater degree of manual dexterity, concentration, and observation; it is vital to keep track of what you are doing, what parts you are removing, and in what sequence you are removing them. That's because the mechanical components we'll be discussing next must be removed in order to be properly cleaned, and certainly prior to lubrication.

If the recorder dates back only to the 1970s or 1980s, and was very clean on the inside when you first removed the cabinet, then you might be relieved of this chore. For all others, however, this next step involves the removal of all rubber idler wheels and the pinch roller in order to clean the shafts with isopropyl alcohol. It may be advisable to remove, clean, and re-assemble those one at a time to eliminate the possibility of putting them back in the wrong place. Also, keep your eye out for dried grease clumps adhering to the base of the shafts. All shafts should be shiny-metal colored when you are finished. Use a wet Q-tip to clean the bushing surface inside the wheels. As you re-assemble these wheels, put a drop or two of light oil on the shafts.

While the oil is in your hand, go

ahead and oil the capstan shaft (sometimes a tiny oil hole is provided for that purpose, and at other times you may find both a front and rear bearing support for the capstan/flywheel assembly; in either case, be certain that all bearing surfaces are oiled). Also apply one drop of oil at each pivot point, where friction and wear can occur. One word of warning here: never over-oil. One or two drops are sufficient. If you use too much, the oil will seep onto surfaces that shouldn't have oil contamination (e.g., rubber) or will simply make a mess that will later become a "dirt farm."

Oiling the motor(s) can be a simple chore, or it can be very difficult—even virtually impossible—as a function of design. If you're lucky, the motors will have either an oil hole through the front and rear bushings (around the motor shaft) or a tiny metal tube protruding through a side opening of the motor enclosure. In either case, use three or four drops of 20 weight motor oil at each hole.

In other cases, however, you will find motors that are said to be "permanently lubricated" by their manufacturer. Sometimes, what that meant was a greased, sealed, bearing race on the front and rear motor-shaft support points. There's not much you can do with motors of that design without resorting to complete disassembly and replacement of the bearings (or somehow re-packing them). Note that no matter the quality of the original components, the grease is now 25 to 50 years old and probably not lubricating very well anymore. Even so, I do not recommend that you disassemble the motors, and certainly not at this point. Just add a drop or two of oil at the point where the shaft enters the motor housing (front and rear). If the motors later prove to work okay (without excessive motor noise), then just leave it go at that, and consider yourself lucky. If that doesn't work out, then you might need to find a motor repair shop for assistance.

You will generally find at least remnants of the areas where grease has been applied to movable chassis components at the factory. These areas should first be thoroughly

cleaned, and then have grease applied. It might be best to clean, and then grease, one area at a time; otherwise, you might forget to re-grease some areas. Use Vaseline in those delicate areas where it's apparent that a heavier grease might upset the movement of low-mass, low-spring-tension, components.

The basic premise here is that if contacting metal parts slide against each other, or the chassis, then grease should be applied. If, on the other hand, parts rotate against each other (i.e., there's a confined space there), then oil should be applied. The logic is that grease applied to confined spaces will eventually cause the rotating parts to seize as contamination, separation, and hardening take place over the years. I'm sure there are a few exceptions to this rule, but not very many.

**Initial Electronics Check.** Now that we've gotten most of the cleaning accomplished and have performed the basic lubrication operations for the mechanics, it's time to turn our attention to the electronics. Prior to the initial power-up, we want to do a bit of electronics cleaning and inspection.

First, carefully inspect the electronics area for signs of overheating. That includes bulging or cracked resistors (take your time and look very carefully here; use a small flashlight to help identify any abnormalities), burned wires, or capacitors with "stuff" oozing out. Make a detailed note of all such occurrences, and replace any suspicious components. For example, a cracked-open resistor in a power-supply section should not only be replaced but also carefully noted. It's possible that the reason it overheated was a shorted electrolytic capacitor on the output side.

Next, grab your can of tuner cleaner and carefully spray clean all potentiometers. To do that, place the can's extension nozzle at the opening where the three electrical contacts emerge from the body and give it a brief spray. Then rotate the control a few times through its complete range.

In some cases, you might find

that the potentiometer is sealed; that is, it has no opening. In such cases you might have the best of all worlds or the worst: The "best" since that usually means the manufacturer used a superior quality potentiometer that was moisture sealed at the factory to prevent contamination; the "worst" is that if and when such potentiometers do become contaminated, there is no simple way to restore proper operation. As a last resort, some have been successful with drilling a tiny hole through the back of the device to allow entry of the spray cleaner. At this point or the operation, if the potentiometers are sealed, just make a note of it and go on.

Finally, while you still have the tuner cleaner in hand, spray clean all switches with exposed contacts, including rotary switches. By the way, most of the available spray cleaners also contain a light lubricant, such as silicone; that helps extend component life.

**Final Inspection.** At this point, check all fuses. That includes rear-panel-accessed fuses—with screw-on caps—as well as internal fuses. Internal fuses are sometimes hidden, so make sure you look all around; some may be "inline" fuses, mounted inside wire-lead holders, while others may be chassis-mounted fuse blocks. In addition to ensuring continuity, make sure that all fuses are of the proper ampere rating and "speed." By speed I mean the length of time before an over-current situation blows the fuse. So-called "slow blow" fuses are often designated "SB." Do not intermix these with the more-common fast-blow types. Make notes in your log of any abnormalities as you go. If a wrong fuse is inserted, it has obviously been replaced; later you must ask yourself "why?" If it has a larger current rating than the manufacturer designated, then you should consider the possibility that the electronics may be drawing excessive current. If that is the case, go back and double check for any over-heated components or wires. If none are found, proceed with the next step.

Okay, we're just about ready for power-up. But before we do, let's take one more look through the

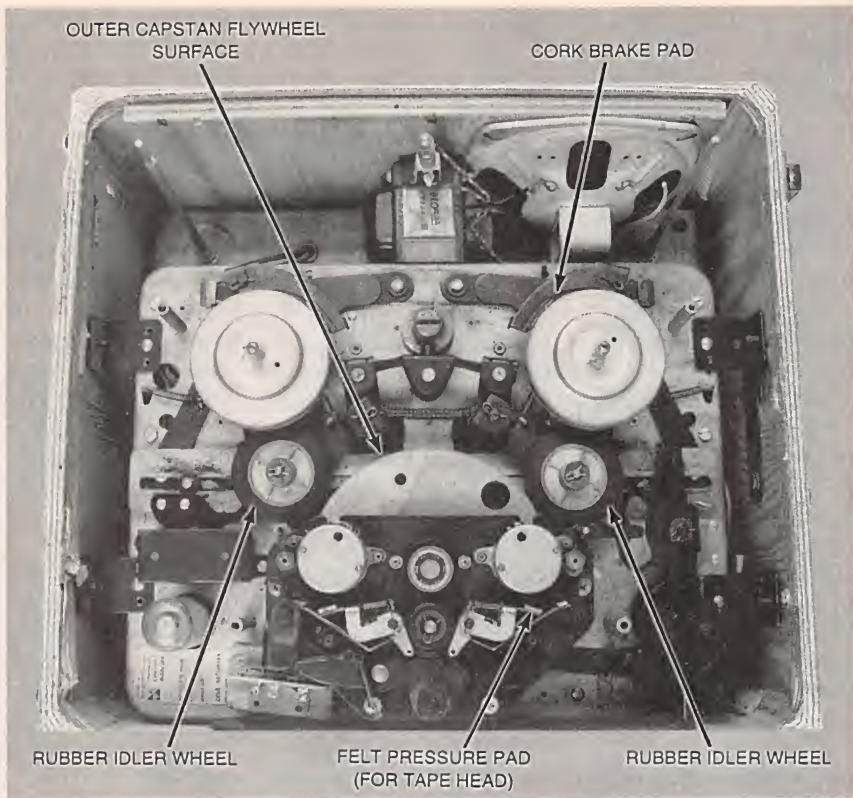


Fig. 5. Some of the internal mechanical components found within a typical recorder. Clean the contact surfaces of the rubber idler wheels and mating flywheel; inspect—but do not moisten—the felt and cork pads.

electronics. If the unit is transistorized, are all the transistors firmly seated in their sockets, with no twisted or "about-to-short-out" leads? Are all internal wires and cables dressed away from any mechanical components, and are they run so that they will not be pinched when the cabinet is re-assembled? Is the AC-line cord still supple and free from any cuts, abrasions, separation at the plug end, or wear at the chassis strain-relief end? Redress, repair, or replace any problems you find, and then re-assemble the cabinet.

**Initial Power-Up.** Finally, we are about ready to see what this recorder can do. I say "about ready" because first, there is a conditioning step that we must go through. What we are trying to accomplish with this next step is to re-condition the electrolytic capacitors in the hope that you will not need to replace them. Without going into detail, electrolytic capacitors deteriorate with time and lack of use, and that deterioration can be made worse by storage conditions, leading to a rather high probability of failure if the AC power

is suddenly applied at full voltage. Instead, by gradually applying that voltage, the capacitors will sometimes re-condition themselves to a point of being quite serviceable again.

Now, connect your Variac to an AC supply. Making sure your recorder is off, with the Variac's voltage control at zero, plug the tape recorder into the Variac. With the recorder in stop mode, and with all volume controls at their minimum position, turn on the recorder. Now slowly increase the voltage up to about 40 volts and then stop. Leave the voltage at this level for about 10 minutes, and then increase the voltage by 10 volts and wait 5 more minutes. Keep repeating that process until you reach about 95 volts, carefully watching the recorder as you do this. Do not leave the room during this procedure! Look for any smoke, hum, noise, or other abnormalities that could be signs of problems. If any of these occur, shut off the Variac, disconnect the power, and correct the problem before proceeding.

Assuming you've been successful

to this point, let's do a quick check on the motors before we load tape on the machine. With the AC voltage still at 95, switch into play mode and, if there is a motor shutoff switch in the tape path (usually that will be on either side of the capstan/pinch-roller area), defeat that switch momentarily by using your finger to move it into the position it would have if tape were threaded. observe what happens.

What should happen is that the pinch roller should be solidly contacting the capstan shaft (that actually would have occurred before tripping the switch in a non-solenoid operated machine), and the take-up reel turntable should be rotating in a counter-clockwise direction. Depending on the type of drive, the supply turntable will probably also be rotating, in a clockwise direction. Before releasing the switch, use your other hand, to check if a light touch on the turntable platforms is sufficient to stop the rotation. (When you do this, stay away from the outer edge of the turntables and the center post, as the turntable edge and the post flanges could be sharp.) While we're not doing a formal calibration here, I do want you to make sure that there isn't an excessive amount of force needed to stop the turntable's motion.

All the turntables are supposed to do in the play or record modes is keep the tape from slackening. Any excessive pulling can stretch the tape, and any significant "jitter" or "fluttering" can increase W/F significantly. If there is excessive pulling, do not proceed until the cause is removed (some tips on that will be offered in the next installment of this series). If there is a little bit of jitter, go ahead and proceed, but make sure you take note of the problem.

**Tape Path Demagnetization.** The next step is to demagnetize the tape path. This is important, and really should be done on a regular basis—let's say after every 10 hours of use. The problem we are trying to correct here is the gradual magnetization of the metal tape guides and heads, which is caused by the electronics, stray external fields, the use

(Continued on page 70)

# BUILD A "HOME-BREW" TEMPERATURE CONTROLLER

DAVID W. BOERTJES



**H**ome brewing can be a very rewarding hobby. Not only is it less expensive to brew wine and beer at home, but depending on how much time and effort one puts into each batch, beverages of excellent quality can be produced.

All home brewers have their own secrets to success, which they may not be willing to share. Two details that most budding brewers tend to overlook have to do with temperature and light. The bacteria responsible for the fermenting process work best at temperatures between 68° and 75°F. Although it is a matter of opinion as to what exact temperature is best, most brewers agree that once a temperature is chosen it should remain constant.

The effect of light on fermentation has been debated among brewers for the longest time. It is the author's opinion that it is best to brew in the dark—especially for wine. The obvious location for brewing under those conditions is a dark basement.

Unfortunately, most basements are also too cold for effective fermentation. Some form of controlled

*One of the secrets of successful home brewing of wines and beers is a constant temperature. Our temperature-controlled heater will keep the temperature of your brews precise and even!*

heater would then be needed. One method that has been tried is a small cabinet just large enough to hold the carboy (the 6-gallon glass jug used for brewing), a household thermostat, and a 60-watt light bulb. The thermostat controls the light, which heats the inside of the cabinet. Unfortunately, there are a couple of drawbacks to this. For one, the bulb gives off light. You could wrap the bulb in aluminum foil to cut down on the light, but that would decrease the bulb's life. Even more of a concern is the fact that a household thermostat usually has a "swing" of several degrees—perfectly fine for a comfortable home,

but not nearly accurate enough for proper brewing.

The solution to those dilemmas is the Home-Brew Temperature Controller presented here. This project is relatively easy and inexpensive to build. The parts can be purchased for about \$70 if you don't have anything on hand already. The electronics are simple enough that the circuit can be constructed on perfboard.

**Designing a Heater.** While the circuitry for a heater with temperature feedback might seem to be an almost trivial matter, there are several finer points to keep in mind when devising such a circuit. The set point should be adjustable over a temperature range of 68°–75°F. The maintained temperature should be within 1 or 2 degrees of the set point so that the system does not "chatter" from rapid switching of the heater's power supply. Whatever switching method is chosen should be flexible enough to control different types of loads such as fans or lights. Choosing low-cost and readily-available components will help

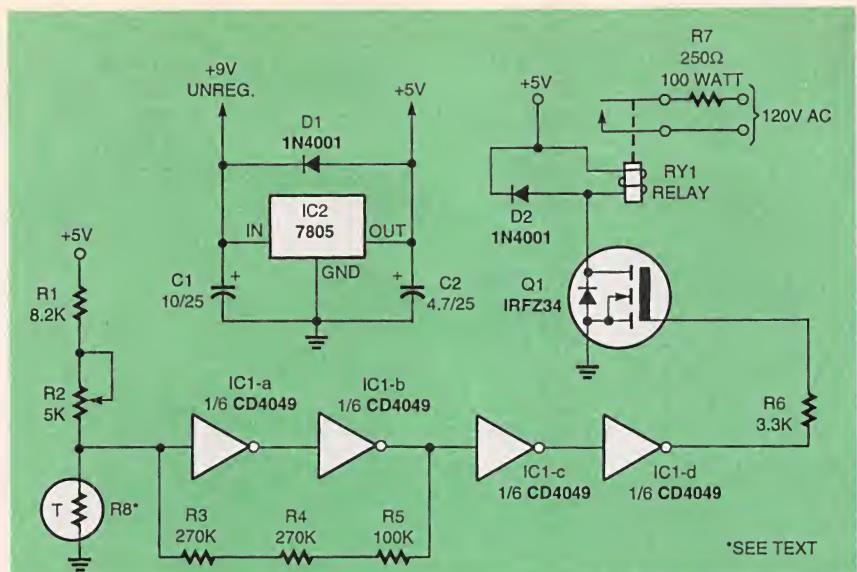


Fig. 1. Although the schematic of the Home-Brew Temperature Controller might appear simple, some sophisticated design work can be seen in the temperature-sensing portion of the circuit. For safety considerations, the "hot" side of the supply line for the heater should be connected to RY1 and the neutral is connected to R7.

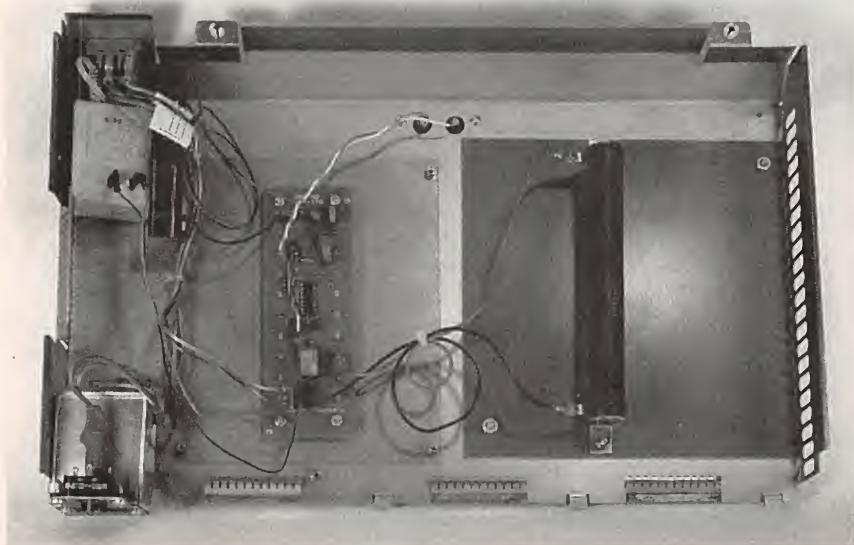


Fig. 2. Here is an inside view of the author's Home-Brew Temperature Controller. Note the use of a fiberglass PC board to insulate the large heating resistor from the metal case. The heating resistor has also been placed near some ventilation holes and is located as far away from the rest of the circuit as possible.

keep expenses to a reasonable level

For the accuracy needed in this project, a thermistor will be used to sense temperature. That device is inexpensive and small, and different units can be selected depending on the temperature range needed. The one we will be using has a negative thermal coefficient. That means that as the temperature increases, the thermistor's resistance will decrease. The thermistor's resistances at some of the temperatures

that we are interested in are listed in Table 1.

The thermistor will be used in a resistor network so that the temperature of the thermistor will generate a variable voltage. To provide the "hysteresis" so that the circuit does not chatter, we'll put an additional resistance in parallel with the thermistor's resistor network. That parallel resistor will be switched so that it is either electrically across the thermistor or across the adjustable set resistor. When placed across the thermistor

tor, the apparent temperature of the thermistor will be higher because of Ohm's Law of resistors in parallel. When placed in parallel with the set-point resistor, the apparent setting will be changed in a similar fashion. The values for the resistors will be chosen so that the circuit will switch off when the temperature is 1°F above the set point and switch on when the temperature drops to 1°F below the set point.

With a digital signal that switches when additional heat is called for, the rest of the circuit is simply a relay that turns a heating element on and off as needed.

**Circuit Description.** The schematic of the Home-Brew Temperature Controller is shown in Fig. 1. The temperature-sensing thermistor is R8, with R2 being the adjustment for the temperature-set point. The values for the combination of R1 and R2 let the set point be adjusted between 8200 ohms and 13,200 ohms—covering the temperature range in which we are interested. Resistors R3, R4, and R5 make up the hysteresis resistance that will be switched between R8 and R2. The 640,000-ohm value of the hysteresis resistors will change the apparent temperature being sensed by the circuit by 1°F. An unusual design point is the use of a CMOS inverter gate in its linear mode. The gate chosen for IC1 switches between its logic-low and logic-high outputs when the input voltage is exactly one-half of the device's supply voltage. The outputs can also be very close to the actual supply-voltage values.

The output of IC1-d drives Q1 so that enough current can be supplied to RY1. When the relay switches on, line current is supplied to R7, a 100-watt power resistor, which acts as the heating element. Power for the circuit is supplied by IC2, a 5-volt regulator.

**Building the Heater.** There are many options when building any circuit, even a relatively simple project such as the Home-Brew Temperature Controller. However, a few cautions are in order. Care must always be taken when using 120 volts AC in any project. With the Home-Brew Temperature Controller,

## PARTS LIST FOR THE HOME-BREW TEMPERATURE CONTROLLER

### SEMICONDUCTORS

IC1—CD4049 Hex CMOS inverter, integrated circuit  
IC2—7805 5-volt regulator, integrated circuit  
D1, D2—1N4001, silicon diode  
Q1—IRFZ34, MOSFET transistor

### RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)

R1—8200-ohm  
R2—5000-ohm, potentiometer  
R3, R4—270,000-ohm  
R5—100,000-ohm  
R6—3300-ohm  
R7—250-ohm, 100-watt  
R8—Thermistor, 10,000-ohm@25° C (RadioShack 271-110 or similar)

### CAPACITORS

C1—10- $\mu$ F, 25-WVDC, electrolytic  
C2—4.7- $\mu$ F, 25-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

RY1—Single-pole, double-throw relay, 5-volt  
9-volt DC wall adapter, case, line cord, brackets for R7, wire, hardware, etc.

however, there is also an element that will become hot. Take some extra time to think about the placement of the heating resistor within the chassis. Any plastic part or wire insulation that gets too close to the heating resistor could melt. Also make sure that all of the high-voltage connections are isolated in a safe manner. It is also a good idea that the unit's metal chassis be grounded and that a 1-amp fuse be wired into the power line.

An example of the author's arrangement is shown in Fig. 2. A ventilated metal chassis that measures 17 inches by 11 inches by 3 inches houses the circuit. Heating resistor R7 is located on one side of the cabinet, with the rest of the circuitry located on the other side. The resistor is also mounted on a sheet of single-sided PC board material. The board's fiberglass is a good insulator for both electricity and heat. The heat insulation helps prevent the top of the case from getting too hot

Temperature	Thermistor Resistance
68°F	12,100 ohms
69°F	11,900 ohms
70°F	11,600 ohms
71°F	11,400 ohms
72°F	11,200 ohms
73°F	10,900 ohms
74°F	10,700 ohms

and becoming a burn hazard. It can be seen that R7 is also mounted with brackets that let air circulate all around the resistor.

The temperature-set resistor, R2, is a PC-mounted trimpot. However, it can also be a panel-mounted potentiometer on the outside of the case. With that arrangement, adjusting the temperature becomes much easier. Unfortunately, accidentally bumping the control can just as easily change the temperature setting, so some type of protection or "lock-out" method would be needed.

Electrical power for the circuit is provided by a 9-volt, 500-mA wall adapter that has been tucked into one corner of the case. Using a surplus adapter can be less expensive in terms of cost and construction time over using a standard transformer, bridge rectifier, and filter capacitor.

The thermistor probe is best made by soldering a pair of twisted wires onto the device and shielding the connections and thermistor leads with two pieces of heat-shrink tubing. A suitable connector on the other end of the wires should mate with a jack mounted on the case. One way to do that is to use spade lugs on the probe wires and a dual-screw terminal on the case.

To set up the Home-Brew Temperature Controller, fill a carboy with water and place an accurate thermometer in it. Set the carboy on the heater in a room where the temperature is always lower than the temperatures you will be needing—an unheated basement will do. Turn on the heater. Over a period of several days, the water will stabilize at a particular temperature. Small changes in the setting of R2 will change the temperature that the heater will maintain. If you used a

panel-mounted potentiometer for R2, you could mark the settings for various temperatures. Once you have set R2 for a particular temperature you'd like to brew at, you're ready to mix your first batch of temperature-controlled brew.

With the addition of the Home-Brew Temperature Controller, the quality and consistency of your batches might improve. It will also give you a warm feeling to know that the heater is faithfully doing its job!



A public service of this magazine



### YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

Electronics Technology Today, Inc.  
P.O. Box 240  
Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and Construction Manual* (160). I enclose a check or money order for \$8.95 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

# FM Transmitters, Understanding the Faraday Disc, and More

LET'S START OFF THIS MONTH WITH A HOT HELPLINE TOPIC THAT HAS BOTH A USEFUL NEW SOLUTION AND A RATHER LONG HISTORY OF CALLER INTEREST. IN PARTICULAR, LET'S TALK ABOUT DEVELOPMENTS IN . . .

## FM Transmitters

Lots of folks want to broadcast over the radio. Why? Perhaps for their own "underground" or "pirate" community radio station; to deliver a commercial "please buy my nice house" realtor message; to free a stage or studio performer from trailing wires; for use in wireless modems or in short-haul telemetry; for surveillance, alarms, or baby monitors; or simply to couple a portable CD player into any nearby home or car radio.

If you only want to broadcast over a few feet, you just need a few milliwatts. To go a hundred feet, you'll need a hundred milliwatts. To cover your neighborhood or town might require ten watts or so. As you might guess, the FCC places very stringent limits on what you are legally allowed to either transmit or broadcast. Anything more than 30 milliwatts or so is probably illegal (but check with your own legal adviser on this).

The FM band resides from 88.1 to 107.9 Megahertz. All the FM-station frequencies are precisely spaced every 200 kHz. Thus, the frequencies always end in an "odd" number such as 93.3 MHz or 99.9 MHz.

Long ago and far away, FM transmitters were built around a simple oscillator, often based on the superb 2N918 transistor. A Varactor or even plain old collector-voltage modulation was used to create mono frequency modulation.

Alas, in those days, most "analog" FM receivers all used powerful automatic fre-

quency-control (AFC) circuits. Those receivers could easily follow any in-band FM carrier, no matter how far off-frequency it was or how much it drifted. But nearly all of today's better FM receivers are digitally synthesized and work only with signals that are both stable and precisely on-frequency. Thus, most of the older and simpler low cost FM-transmitter circuits will no longer work well.

The first step in correcting that situation was a potent chip known as the Rohm BA1404. That IC provided high-quality audio by way of its 38-kHz crystal-derived stereo modulation. But the internal RF oscillator was still flaky enough that it drifted unacceptably.

So, how can you build your own FM oscillator that is both stable and always on-frequency? There are two main routes that you can use, but before we go further, we need to clarify one concept: A stable FM system is really a contradiction in terms, as its frequency changes with the musical or voice content. What

you want is its center frequency to be rock stable.

The "correct" and complex way to deal with this is with a variation on a PLL called the frequency-locked loop. You first build an FM oscillator. Then you build a crystal oscillator that operates at the same center frequency. The average frequency of the two are compared and integrated, or low-pass filtered. The resulting error voltage from the low-pass filtering is a near DC waveform that's used to continuously correct the FM oscillator, thus forcing it to the designed frequency.

The frequency-locked loop method is how the situation is handled in commercial FM transmitters. The big problem for the home builder or experimenter is that a lot of parts are needed in a fancy circuit.

The other technique is to use capacitive loading to pull a crystal in frequency. The question is can you pull an ordinary crystal enough to be useful here? The usual rule of thumb is that you can pull a crystal up to one tenth of a percent, which does translate to 100 kHz up at 100 MHz. But that tenth of a percent is usually an outside limit. Also, sadly, the pulling process is usually nonlinear.

Both Sony and Pioneer found that they could pull special crystals in hard-to-design but simple, low-cost circuits. The results were the old Pioneer CD-FM-1 and the Sony XA-7A FM-stereo modulators. No longer made and now hard-to-find, the Pioneer unit is single channel, but is easily modifiable and worked upon; the Sony version is dual channel, but smaller and difficult to adapt. Interestingly, Sony actually managed to linearly pull their special crystal over two adjacent FM channels using switched bias.

## NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster  
Synergetics  
Box 809-EN  
Thatcher AZ, 85552  
Tel: 520-428-4073

US email: [don@tinaja.com](mailto:don@tinaja.com)  
Web page: <http://www.tinaja.com>



## SOME FARADAY DISC RESOURCES

Beaty, Bill, "Untried Homopolar Generator Experiments," online at [www.eskimo.com/~billb/frenerg/n-mach.html](http://www.eskimo.com/~billb/frenerg/n-mach.html)

Becker, Richard, *Electromagnetic Fields and Interactions*, Dover, 1982. Sections 87 & 88

Cantor, Gooding, & James, *Michael Faraday*, Humanities Press, NJ, 1996

Faraday, Michael, *Experimental Researches in Electricity*, Britannica Great Books, vol. 45, 1952

Feynman, Richard, *The Feynman Lectures on Physics*, Addison Wesley, 1989

Hide, "A Study of Two Self-Exciting Single-Disc Homopolar Dynamos," Proc R Soc. London A v452, pp1369-95

McAllister, "Friction On A Rotating Disc In A Magnetic Field," online at [ww2.hawaii.edu.suremath/jdisk1.html](http://ww2.hawaii.edu.suremath/jdisk1.html)

Miller, A. I., *Albert Einstein's Special Theory of Relativity*, Addison Wesley, 1981

Moroz, "On Self-Excited Coupled Double Disc Homopolar Dynamos Driving Series Motors," *Physica D*, 1997

Valverde, "Principle of Relativity as Applied to Motional Electromagnetic Induction," *American Journal of Physics*, v63 #3, p228

Valone, Thomas, *Homopolar Handbook*, Integrity Institute Press, 1994, Washington, DC

frequency channels. Note particularly the 1000-ohm resistor in the final output stage. RadioShack apparently added this in their "A" version to sharply reduce the range. That might have been done to meet an out-of-band harmonic spec, to lower distortion, or to discourage adding an illegal external power booster.

There's a small user's manual that comes with the modulator. The more detailed service manual (having full schematics and updates) is available as a special order for \$7 or so. Ask your RadioShack dealer for details.

## More On the Faraday Disc

Some enigmas are more enigmatic than others: It turns out the odd behavior of the Faraday disc is even stranger than I thought it was. In November, 1997 (MUSE117.PDF on [www.tinaja.com](http://www.tinaja.com)), we looked at homopolar generators. The Faraday Disc is one variation on the homopolar generator where the input magnetic field is also rotated.

The key question is this: When you have any perfectly uniform magnetic field is there any way you can tell that the field is rotating? Well, a classicist would say "Of course you could tell if the field is spinning. The lines of force are busy cutting conductors and are inducing voltage." A relativist would instead say "There is no way to tell. There are no such things as magnetic lines; a uniform field is in fact uniform. Further, the laws of general relativity demand field motion independence, especially at high speeds."

It took well over a hundred years to sort this one out, and as far as we know today, the relativists are correct: You cannot tell if a perfectly uniform magnetic field is rotating or translating. One source for that hard-to-visualize and even harder-to-believe result is in Richard Feynman's *The Feynman Lectures on Physics* Volume II, section 13.10. A well-documented and peer-reviewed experiment (Valverde's "The Principle of Relativity as Applied to Motional Electromagnetic Induction") you can run yourself is found in the *American Journal of Physics*, Volume 63 #3 for March of 1995. All the nasty math involved lies in a Richard Becker's *Electromagnetic Fields and Interactions*, Dover 1982, sections 87 and 88; section 87 is background information and section 88 is on unipolar induction itself.

Figure 3 shows you a simple experiment. Hang a magnet vertically on a

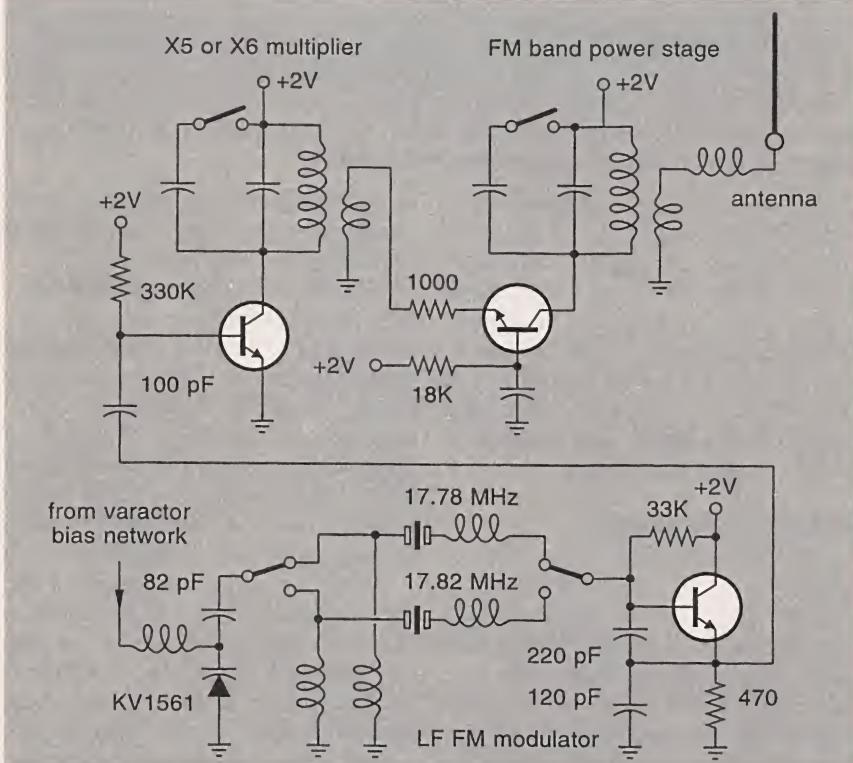


FIG. 2—THE RF-MODULATOR PORTION of the RadioShack 12-2051 FM Stereo Transmitter. The use of 5 $\times$  and 6 $\times$  multiplication improves linearity and simplifies the circuit design.

tals. The voltage on the variable capacitor is the sum of the L+R mono audio channel, an L-R signal on a 38-kHz subcarrier, and possibly a DC fine-tuning value. The first stage oscillates in the 18-MHz region. The second stage then multiplies by five for the two low channels or by six for the two high channels. The final circuitry is a grounded-base linear amp that operates at FM-band frequencies.

Switching can add extra tuning capacitance to the multiplier and output stages.

Shifting your tank resonance accommodates either the high or low channels.

Note that I've simplified Fig. 2 a tad for clarity. The high-low switching is really done with NPN transistors. Further, each of the stages is independently decoupled from +2 VDC by its own RC filter network. Again, see the RadioShack documentation if you need additional details.

Two mechanical switches are used for frequency selection. One picks the crystal; the other peaks for low- or high-

string. Position another vertical magnet below the first one and rotate it around the string axis. Your upper magnet should not rotate. It should only be attracted or repelled by the bottom one, but not spun. That strongly suggests that any magnetic "lines" do not move with a magnet's rotation.

Your easiest access to Faraday's ori-

nal *Experimental Researches in Electricity* are in the Britannica Great Books series, volume 45. One quite readable book about Faraday is a Cantor, Gooding, and James' text entitled *Michael Faraday*. I've listed these and a bunch of additional key books and papers about Faraday Discs in the "Some Faraday Disc Resources" sidebar, which can be found elsewhere in

this article.

The Faraday disc output seems to depend only upon the strength of the input magnetic field and the relative speeds of the disc rotor, and the slip ring and meter stator. The speed or direction of the magnets do not seem to matter in the least!

Apparently, the E field and the H field cannot stand alone. They are both essential parts of your result. Thus, any motional energy seemingly missing from the one component is made up by the other. You'll have to consider both E and H together any and every time there is any relative reference motion!

Since it apparently does not matter whether the magnetic field rotates, there's probably not any point at all in purposely spinning your magnets, at least in machines of this type. Rotating magnets would add to the mass, wind resistance, and dynamic braking, and make closing the flux path a lot harder, while not otherwise changing the outcome in any useful way. Thus, there is no compelling use for a spinning magnet Faraday disc. At least none that I can think of, beyond "gee whiz" demos.

No matter whether its magnetic field rotates or not, all homopolar generators and all Faraday discs must obey the same laws of conservation of energy that other generators do. While counter EMFs and counter torque mechanisms are not obvious, they most certainly do exist. More on this in the superb Untried Homopolar Experiments Web site shown in the listing.

There is no magic here. Nor is there any way I see that any "overunity," "free-energy," or "zero-point" energy device can possibly ever result. All attempts to do otherwise to date have ludicrously and miserably failed. The usual problems are the inability to properly measure true AC power, inept failures to comprehend counter EMFs or torques, and outrageously absurd "not even wrong" theories.

After my much closer look, I now understand how any "free-energy" enthusiast could get severely misled with such a counterintuitive and unobvious way of generating a plain old DC current. Thanks to Bill Beatty, Clarence Green, and John Vanco for all their considerable input on this topic. Let me know if you have any more "real science" references for me here. An Incredible Secret Money Machine II for your thoughts. Let's hear from you.

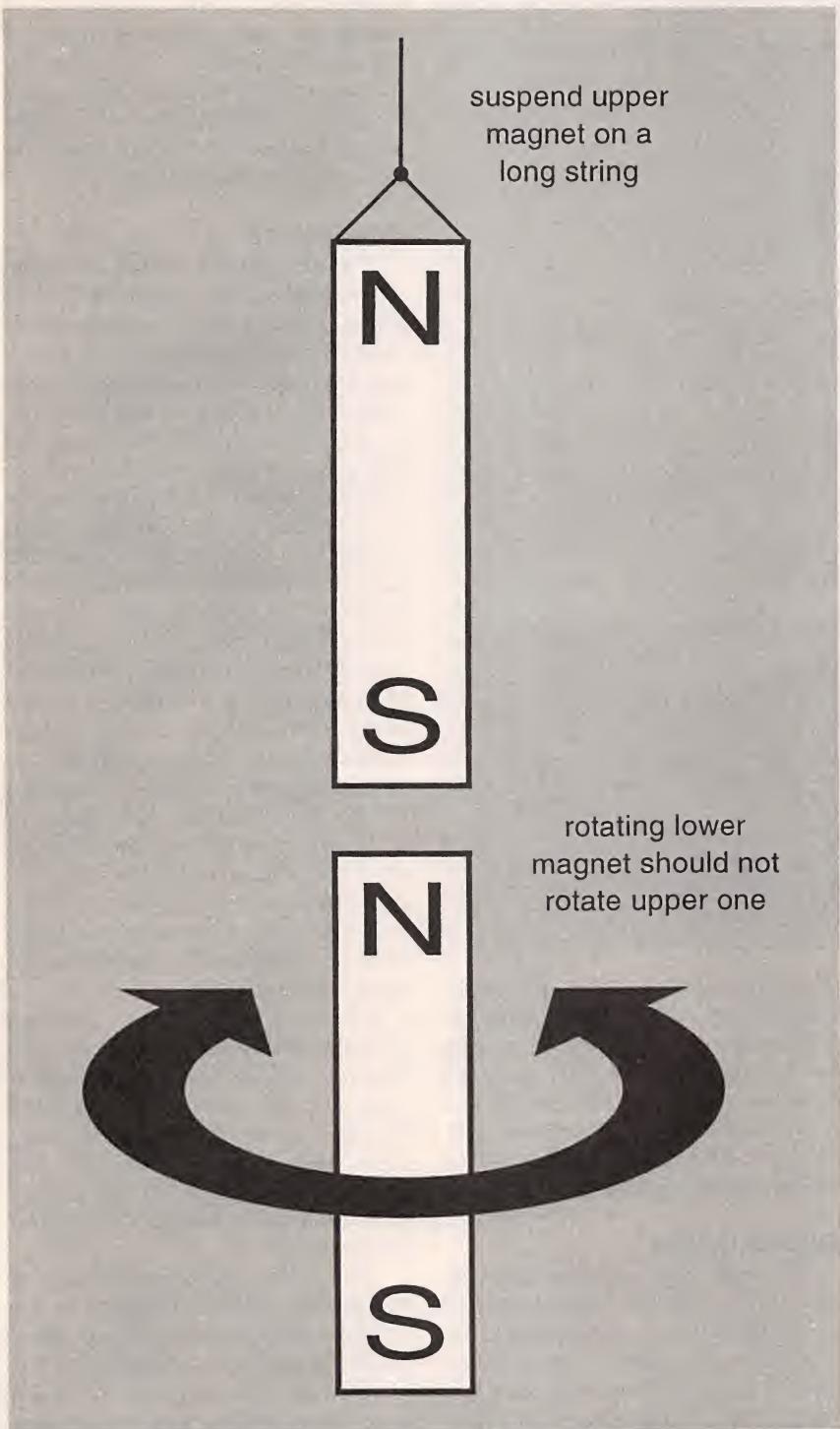


FIG. 3—THE LAWS OF GENERAL RELATIVITY demand that you cannot tell if a uniform magnetic field is rotating or translating. Therefore, if you rotate the bottom magnet about the string axis, the top magnet should remain stationary.

## NAMES AND NUMBERS

### Amazon Books

Box 80387  
Seattle, WA 98108  
(800) 201-7575

### B&B Auctions

3211 S 43rd Avenue  
Phoenix, AZ 85009  
(602) 353-0016

### Bentley Auctioneers

3801 Academy Pkwy North NE  
Albuquerque, NM 87109  
(505) 344-1812

### Closeout News

500 Century Lane  
Holland, MI 49423  
(616) 392-9687

### Cypress Semiconductor

3901 N First St.  
San Jose, CA 95134  
(800) 858-1810

### Industrial Market Place

7842 N Lincoln Ave.  
Skokie, IL 60077  
(800) 323-1818

### Inframetrics

16 Esquire Road  
North Billerica, MA 01862  
(508) 670-5555

### Integrity Research Institute

1377 "K" St. NW #204  
Washington, DC 20005  
(800) 295-7674

### International Journal of Refrigeration

655 Avenue of the Americas  
New York, NY 10010  
(888) 437-4636

### Lindsay Publications

PO Box 538  
Bradley, IL 60915  
(815) 935-5353

### Maxim

120 San Gabriel Dr.  
Sunnyvale, CA 94086  
(800) 998-8800

### Newnes

225 Wildwood Ave.  
Woburn, MA 01801  
(800) 366-2665

### Pioneer

Box 1720  
Long Beach, CA 90801  
(213) 835-6177

### Rohm Corporation

2150 Commerce Drive  
San Jose, CA 95131  
(408) 433-2225

### Sony

9 W 57th St., 43rd Fl  
New York, NY 10019  
(212) 371-5800

### Synergetics

Box 809  
Thatcher, AZ 85552  
(520) 428-4073

### Tech Capital

8500 Leesburg Pike  
Suite 7500  
Vienna, VA 22182  
(703) 848-2800

### UT Electromechanics

PRC-EME 1.418A  
Austin, TX 78758  
(512) 471-4496

munity colleges, many of whom seem to be sharply cutting back on electronics programs.

Two auction houses I have found interesting are Bentley Auctioneers in Albuquerque (mostly Los Alamos stuff) and B&B Auctions in Phoenix (mostly Intel). One guide to general surplus and distress merchandise is *Closeout News*. Another trade journal with lots of mechanical and electrical items is *Industrial Marketplace*.

I've got a new surplus and auction story up as RESBN73.PDF and for some surplus bargains of my own, check into [www.tinaja.com/barg01.html](http://www.tinaja.com/barg01.html).

## New Tech Lit

The new MAX126 chip from Maxim is a switchable four-channel, 14-bit A/D converter that is able to simultaneously sample all its inputs. That is super important for real power measurement, especially when strange waveforms or nonlinear loads are involved. The device appears able to handle exceptionally high crest or pulse factors with ease. Up to now, accurate measurement of real power has usually been both outrageously expensive and painfully difficult. Thankfully, their MAX126 just might be able to single-handedly blow away much of the "free energy" hogwash currently polluting the Web, and open up all sorts of great new motor control and home energy-conservation applications. More details and free samples are at [www.maxim-ic.com](http://www.maxim-ic.com) I'll try to work up a PIC wattmeter on this.

From Cypress comes a new CD ROM on the Universal Serial Bus and their related low-cost microcontrollers. From Inframetrics, there are free demo disks on their new ThermaCAM infrared-imaging instruments.

Additional information on nitrogen powered cars appears at [www.aa.washington.edu/AERP/CryoCar.htm](http://www.aa.washington.edu/AERP/CryoCar.htm) and at [www.mtsc.unt.edu/CoolN2Car.html](http://www.mtsc.unt.edu/CoolN2Car.html). Among a few other compelling advantages (such as a potential 20X cost reduction over comparable pure EVs), this new idea sure simplifies summer air conditioning!

The pricey *International Journal of Refrigeration* seems to be the definitive scientific publication on cooling topics. Their Volume 20 has a tutorial on thermo-acoustic refrigerators in it. This is an apparently valid scheme to use high-pressure standing sound waves to move thermal energy.

(Continued on page 70)

reluctance AC as the "best" solution to hybrid electric vehicles. I also feel that the optimum number of motors per car might end up something like 4000 to 40,000 millimotors instead of just four humongous ones, the same distributed way a dollar power FET is really half a million devices working together in parallel.

## Surplus Update

The Feds have recently cleaned up their surplus Web site ([www.dms.gov](http://www.dms.gov)); it is arranged better and far easier to use than before. But military surplus doesn't seem all that great these days. You'll find much better bargains at downsizing research labs and commercial firms. One often-overlooked source for incredible test-instrument buys are outlying com-

# Take This Giant Circuit Library For Only \$495

when you join the  
**Electronics Engineers' Book Club®**

Hundreds of circuit ideas  
alphabetically arranged—from  
Alarm circuits to Zero  
crossing detector circuits!

“...includes schematics for the latest electronics  
circuits from industry leaders...” —Popular Electronics

Turn to this comprehensive circuit library for hundreds of project ideas...valuable troubleshooting and repair tips...and concise pinout diagrams and schematics. Each volume contains more than 700 electronic and integrated circuits and covers 100+ circuit categories.

If coupon is missing, write to: **Electronics Engineers' Book Club® A Division of The McGraw-Hill Companies** P.O. Box 549, Blacklick, OH 43004-0549

## As a member of the **Electronics Engineers' Book Club...**

you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main Selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 2 more books during the next 12 months, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program. Publishers' Prices Shown © 1998 EEBC

## The Encyclopedia of Electronic Circuits Volumes 1-3

by Rudolf F. Graf



**2,344 total pages  
3,490 total illustrations**

## **ELECTRONICS ENGINEERS' BOOK CLUB®**

*A Division of The McGraw-Hill Companies, P.O. Box 549, Blacklick, OH 43004-9918*

**YES!** Please send me *The Encyclopedia of Electronic Circuits-Vols. 1-3* (5857863), billing me just \$4.95, plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books without obligation and have my membership cancelled.

Name \_\_\_\_\_

Signature \_\_\_\_\_

Address/Apt.# \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Zip \_\_\_\_\_ Phone \_\_\_\_\_

Valid for new members only, subject to acceptance by EEBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

RPIF398

## REEL RECORDER

(continued from page 58)

of magnetized tools, or even improper previous use of the recorder. Whatever the cause, that condition could damage prerecorded tapes by erasing high-frequency passages.

With the demagnetizer at least three feet away from the recorder, and with the recorder turned off, plug in the demagnetizer and slowly bring it close to the recorder, sweeping close to—but not touching—the guides and heads. One or two passes are sufficient; then move the demagnetizer at least three feet away before unplugging it. The technique here is to always keep the demagnetizer moving slowly—never let it stop and never abruptly change direction. To do so could actually cause magnetization. Also, don't leave the demagnetizer plugged in for more than about 30 seconds as it typically draws lots of current and is not designed for continuous duty.

**Time to Load the Tape!** So, now—finally—we have gotten the machine into sufficient shape to where we can actually check it out with tape! We know it's clean (inside as well as outside); we've performed numerous safety checks (line cord, fuses, wiring, components); we know it has sufficient lubrication; we know the active electronic devices are all in place (tubes and transistors); and we are confident that any tape we thread on this machine will not become contaminated, stretched, or partially erased.

For this final step in our preliminary check-out procedure, thread a "work" tape (that is, a tape with some non-replaceable, but high-quality, pre-recorded stuff along with some room for new recordings) onto the machine. You may now directly power the recorder from the AC line; the Variac should no longer be needed.

You might begin by simply getting a feel for the transport controls. At first, don't allow the tape reels to move very fast. Instead, go into the fast-forward and rewind modes for

just a second or two; then hit stop. Do this for progressively longer periods of time until you become confident that both the wind motors and the brakes are working well before moving on.

Take note of any abnormalities here, such as excessive initial force being applied to the tape when a fast-wind mode is begun or insufficient pulling force (slow wind). If the latter problem is present, check to see whether it is really due to low pulling force, or whether it's due to excessive back tension on the opposite reel. For example, in rewind mode, the take-up reel turntable should normally have only a very light amount of counter-clockwise rotational force. If that "back tension" is too great, the tape will not rewind quickly; in the worst case, the tape could be stretched in the process.

Remember that these are just initial gross-tension checks to ensure that we can safely move tape in all transport modes. We'll cover detailed tension measurements next time.

If all is well so far, turn up the volume a bit and note the quality of reproduced, pre-recorded sound. Assuming the original was good stuff, the playback should also be good. This is, of course, still a quick preliminary test—nothing scientific. Now proceed to make a recording; really anything will do here—familiar music is fine, or even a 1-kHz tone to get a quick feel for W/F. Again, note any problems encountered.

That concludes our preliminary conditioning and check. One final note though for those of you who were unable to complete these steps due to faulty electronic or mechanical parts. Any faulty components will have to be replaced before you can go on with the restoration. Broken belts; worn-out rollers or bearings; bad vacuum tubes, transistors, or other components; shorted motors; and even bad AC-line cords all must be replaced before you can proceed with the restoration.

That's all the room we have for now. Next time, we'll look deeper into what we must do to bring our old recorder back to its full, original glory.  $\Omega$

## TECH MUSINGS

(continued from page 66)

The second trade journal this month is *Tech Capital*. As its name implies, this one is on venture funding.

Peavey's *Fuel from Water* is this month's misnamed but highly useful home and auto hydrogen book from Lindsay Publications. More details on their [www.keynet.net/~lindsay](http://www.keynet.net/~lindsay) web site. From Newnes comes the new *Audio Power Amplifier Design Handbook*, by Douglas Self.

By the way, I am now an Amazon Books associate. More information on that can be found at [www.tinaja.com/amlink01.html](http://www.tinaja.com/amlink01.html)

For most individuals and smaller-scale startups, nearly all of the time, patents are virtually certain to end up as a net loss of time, energy, money, and sanity. Find out why along with my tested and proven alternatives that do work in the real world in my *Case Against Patents* package per my nearby Synergetics ad, or view [www.tinaja.com/patnt01.html](http://www.tinaja.com/patnt01.html).

I have recently added new Santa Claus Machines and Golly Gee Mr. Science library pages to my Guru's Lair at [www.tinaja.com](http://www.tinaja.com). You'll also find my freshly updated Synergetics catalog along with some new, free, and linked Hardware Insider Secrets. Be certain to check out meowwrrr's new SureGrip magnetic paws. As usual, most of our mentioned items should appear in the Names & Numbers or Faraday Disc Resources sidebars. Always be sure to look there before you phone our US technical helpline shown in that Need Help? box you'll find nearby.

EN

### SC552ES CONTROLLER



- 80C552 @ 22MHz
- Enhanced BASIC Language
- 6" x 9" circuit board
- 10 SA relay outputs
- 3 LED or logic outputs
- 16 opto-isolated inputs
- 8 ch. 10 bit analog inputs
- 2 ch. 8 bit analog outputs
- Real Time clock/calendar
- 128K Static RAM
- 128K FLASH memory
- 256 byte serial EEPROM
- 3 serial ports (RS232/485)
- IIC bus expansion
- Plug-on I/O terminal blocks
- Single 12Vdc operation

#### APPLICATION READY ONLY

349.95

**SYLVA**  
CONTROL SYSTEMS

519 Richard Street, Thunder Bay, Ontario, Canada P7A 1R2

Ph. 807-768-2487 Fax 807-767-0587

[www.sylvacontrols.com](http://www.sylvacontrols.com) [info@sylvacontrols.com](mailto:info@sylvacontrols.com)

# Electronic SHOPPER®

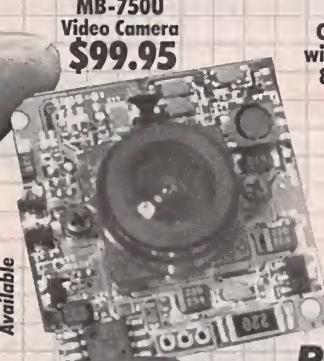
SUPPLEMENT TO ELECTRONICS NOW MARCH 1998

## MICRO SIZE CCD VIDEO CAMERAS

MB-750U  
Video Camera  
**\$99.95**

MB-705UX  
C-Mount Camera  
with Lens Included;  
8 or 12mm Lens  
your choice!

Pinhole Versions  
Available



See More Products @

**Polaris Industries**  
<http://www.polarisusa.com>

**800.752.3571**

**Free Catalog**

470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

## TEST EQUIPMENT SALES



MC & VISA  
ACCEPTED

TEK SG504.....1 GHz SINE WAVE GENERATOR.....\$2695  
HP 8111A.....PULSE/FUNCTION GENERATOR.....\$1795  
TEK 2465A.....350 MHz 4 CH. SCOPE.....\$3795  
TEK 2445A.....200 MHz 4CH. SCOPE.....\$2395  
HP 8902A w/ opts.....MEASURING RECEIVER.....\$25795  
TEK 465.....100 MHz 2 CH. SCOPE.....\$495  
TEK SG503.....LEVELED SINE GENERATOR.....\$695  
HP 3325A.....SYNTH./FUNC. GENERATOR.....\$1995  
TEK 7L5.....SPECTRUM ANALYZER P/I.....\$1295  
(INCLUDES L3 MODULE)

TEK 7L18.....18 GHz SPEC. ANALYZER.....\$1995  
BMI 2400.....POWER LINE MONITOR.....\$995  
HP 8656A.....SIGNAL GENERATOR.....\$1895  
HP 8640B.....SIGNAL GENERATOR.....\$995  
TEK 11A34.....4 CHANNEL PLUG-IN.....\$1795  
HP 5314A.....UNIVERSAL COUNTER.....\$395  
WAV 801.....50 MHz PULSE GENERATOR.....\$795  
HP 6002A.....50V 10A POWER SUPPLY.....\$795  
FLUKE PM2811.....30V 10 POWER SUPPLY.....\$1195.



NEW SCOPES  
IN STOCK

P.O. BOX 986  
LONDONDERRY, NH 03053

PHONE (800) 684-4651  
FAX (603) 425-2945

ASK ABOUT OUR NEW  
TEKTRONIX & FLUKE  
PRODUCTS

CALL TOLL FREE  
(800) 292-7711 orders only  
Se Habla Español

# C&S SALES

## EXCELLENCE IN SERVICE

LOOK FOR OTHER  
MONTHLY SPECIALS  
ON OUR WEBSITE

**NEW** **XK-700 Digital / Analog Trainer**  
Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

**XK-700**  
Assembled and Tested  
**\$189.95**

**XK-700 - SEMI KIT**  
w/ Fully Assembled PC Board  
**\$174.95**

**XK-700K - Kit**  
**\$159.95**



Made in the USA

### 20MHz Sweep / Function Generator with Freq Counter

**B&K 4040**

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

10MHz B&K 4017 \$309  
5MHz B&K 4011 \$239



**\$399**



### Model M-6100

The M-6100 is Elenco's most sophisticated meter with almost every possible feature available. The M-6100 even has a computer interface for viewing and storing data on a personal computer. It comes complete with software, RS-232 cable, test leads and manual.

**\$125**

### SATELLITE FINDER

**Model SF-100A**

- Aligns Satellite Dishes
- Range 950-2050MHz
- Audio Tone
- Compact Size
- Self Power Check

**\$39.95**



### Digital Multimeter Model M-1700

**\$39.95**

11 functions including freq to 20MHz, cap to 20 $\mu$ F. Meets UL-1244 safety specs.



### The New DMM900 Series Handheld Digital Multimeters

For high-performance digital multimeters that are accurate, reliable, and rugged, the DMM900 Series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capability that spans voltage, current, digital multimeters features a dual numeric display, 3-year warranty, and autoranging capability. All backed by the reliability of the Tektronix brand.

#### Features

**DMM912, DMM914,  
DMM916**

- 40,000 Count Display
- 0.06% Basic DC Volts Accuracy (DMM916)
- DC Voltage Ranges from 400mV to 1,000V
- AC Voltage Ranges from 4V to 750V (True RMS)
- AC and DC Current Ranges from 10,000 $\mu$ A to 10A
- Resistance Ranges from 400 $\Omega$  to 40M $\Omega$
- Capacitance Ranges from 4nF to 40 $\mu$ F
- Frequency Ranges from 400Hz to 2MHz
- Temperature Measurements from -50°C to +980°C (DMM916, DMM914)
- 3 Year Warranty
- CE Marking



**DMM 912**  
**\$189**



**DMM 914**  
**\$235**



**DMM 916**  
**\$275**

**GUARANTEED LOWEST  
PRICES ON TEK DMMs**

### AK-700

**\$14.95**

Phone kit  
with training  
course.



### RADIO CONTROL CAR KIT

**MODEL AK-870**

- 7 functions
- Remote control included

**\$24.95**

No Soldering Required



### Model AM/FM-108K Transistor Radio Kit

With training course

**\$29.95**



### 35mm Camera Kit

Learn all about photography  
**AK-540**

**\$14.95**



No Soldering Required

### WE WILL NOT BE UNDERSOLD

# C&S SALES, INC.

UPS SHIPPING: 48 STATES 5%  
OTHERS CALL FOR DETAILS  
IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 541-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)



**15 DAY MONEY BACK  
GUARANTEE**

**FULL FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Same Day  
Shipping

### Fluke Scopemeters



123....NEW.....	\$950
92B.....	\$1445
96B.....	\$1695
99B....NEW....	\$2095
105B.....	\$2495

ALL FLUKE  
PRODUCTS  
ON SALE

### B & K PRECISION SCOPES



100MHz THREE-TRACE  
Model 2190A  
• 1m/Division sensitivity  
• Sweeps to 5m/division  
• Dual time base  
• Signal delay line  
• 15KV accelerating voltage  
\$1295.00



60MHz DUAL-TRACE  
Model 2160  
• 1m/Division sensitivity  
• Sweeps to 5m/division  
• Dual time base  
• Signal delay line  
• V-mode displays two signals unrelated in frequency.  
• Component tester  
\$895.00



40MHz DUAL-TRACE  
Model 1541C  
• 1m/Division sensitivity  
• Video sync separators  
• Z-axis input  
• Single Sweep  
• Mode displays two signals unrelated in frequency  
• Component tester  
\$695



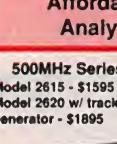
60MHz, CURSORS & READOUTS, DUAL TIME BASE  
Model 2260  
• Cursors and readouts  
• 1m/Div sensitivity  
• 23 calibrated ranges - main time base  
• 19 calibrated ranges - delayed time base  
• Signal delay line  
• V-mode - displays 2 signals unrelated in frequency.  
• Component tester  
• Z-axis input  
• Single sweep  
\$1225



20MHz DUAL-TRACE  
Model 2120B - 2 Year Warranty  
Special \$375



Model 2125A with delayed sweep  
\$539.95



500MHz Series  
Model 2615 - \$1595  
Model 2620 w/ tracking generator - \$1895

1.05GHz Series  
Model 2625 - \$2395  
Model 2630 w/ tracking generator - \$2995

Affordable Spectrum  
Analyzers by B & K

### C & S SALES

Your one stop source for  
all your electronic needs!

CALL OR WRITE FOR OUR

NEW FREE 64 PAGE

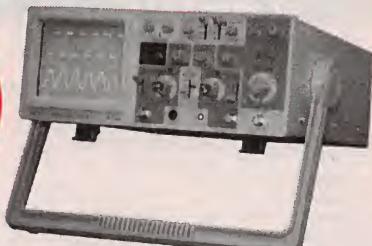
CATALOG!

(800) 445-3201

### Quality Scopes by Elenco

Lowest Prices of the Year!

Includes  
Free Dust  
Cover and  
Probes



60MHz

DS-603 \$1350

- Analog / Digital Storage
- 20MS/s Sampling Rate

S-1360 \$749

- Analog with Delayed Sweep

100MHz

S-1390 \$995

- Analog

40MHz

S-1345 \$569

- Analog with Delayed Sweep

S-1340 \$475

- Analog

25/30MHz

DS-303 30MHz \$1095

DS-203 20MHz \$725

- Analog / Digital Storage

S-1330 \$439

- 25MHz Analog
- Delayed Sweep

S-1325 \$325

- 25MHz Analog

2 Year  
Warranty

### SIMM MODULE TESTER

B & K 898 \$625

- Tests 72 and 30-pin SIMMs to 36 bits.
- Stand alone and portable. No other equipment required.
- Automatically identifies width, depth and speed of SIMMS.
- 10 built-in tests identify most memory defects.
- Preheat cycle prior to test.



### Fluke Multimeters

Model 70III	\$85	Model 83	\$235
Model 73III	\$115	Model 85	\$269
Model 75III	\$139	Model 87	\$289
Model 77III	\$154	Model 863E	\$475
Model 79III	\$175	Model 867BE	\$650

### PORTABLE SEMICONDUCTOR TESTER

B & K 510

- In or out-of-order circuit tests for transistor, FETs, SCRs and darlings.

\$199.00

### B & K Precision Multimeters

Model 391	\$143	Model 388A	\$99
Model 390	\$127	Model 2707	\$75
Model 389	\$109	Model 2860A	\$79
Model 5390	\$295	Model 5370	\$219
Model 5380	\$265	Model 5360	\$195

MX-9300

Four Functions in One Instrument

### Features:

- One instrument with four test and measuring systems:
  - 1.3GHz Frequency Counter
  - 2MHz Sweep Function Generator
  - Digital Multimeter
  - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @2A



\$459.95

GUARANTEED LOWEST PRICES

C & S SALES, INC.

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 541-9904 (847) 541-0710  
[http://www.elenco.com/cs\\_sales/](http://www.elenco.com/cs_sales/)



15 DAY MONEY BACK  
GUARANTEE

FULL FACTORY WARRANTY  
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

UPS SHIPPING: 48 STATES 5%  
OTHERS CALL FOR DETAILS  
IL. Residents add 8.25% Sales Tax

# SEC Sun Equipment Corporation

P. O. Box 97903, Raleigh, NC 276 24-7903

## Test Equipment for Cost-Minded People

LODESTAR Lodestar Electronics Corp. Since 1979

One Year Warranty. 15 Day Money Back Guarantee. OEM welcome. School purchase order accepted. Bids accepted. VISA, DISCOVER

SALES REP/DISTRIBUTORS/OEM WANTED. MASTER, & AMER. 1-800-870-1955/(919)870-1955 24-hr Fax:(919)870-5720

### DC POWER SUPPLY

PS-303 \$159.00  
0-30VDC, 0-3A; 0.02%+2mV line regulation; 0.02%+3mV load regulation; 1mVrms noise & ripple; Short circuit/overload protection; constant current/voltage(CC/CV). PS-303D \$314.95 dual, tracking

PS-305 \$219.95, 0-30VDC, 0.5A.

PS-305D \$399.95, dual, tracking. \$110 \$289.95 0-60VDC, 0-3A. \$112 \$399.95 0-60VDC, 0.5A. \$108(810) \$549.95 (\$699.95) 0-60VDC, 0-3A(5A), dual, independent tracking. Low noise \$102(810) \$399.95 (\$489.95) triple output, 0-30V/0-3A(5A) x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection. PS-1610S(810) \$289.00 (\$399.95) 0-16VDC(0-30VDC), 0-10A. PS-2243(2245) \$139.00 (\$159.00) 0-12-0-24VDC, 3A(5A). \$200(8201) \$179.95 (\$239.95) 0-30VDC(digital meter), 0-3A(5A). \$210(8211) \$199.95 (\$259.95) two digital meters \$202(8203) \$499.95 (\$549.95) 3 outputs, digital display, dual 0-30VDC/0-3A(5A), a fixed 5VDC/3A, independent tracking operation, constant voltage and current.

### AM/FM SWEEMER SCOPE

SM-6225B/C \$1999.95  
Freq Range: (AM)400KHz, (FM) 10-11.4MHz, Accuracy: ± 0.1%  
Marker: (AM)455KHz, ±5KHz, ±10KHz; (FM)10.7MHz, ±7.5KHz, ±150KHz.

STEREO SCOPE OS-7505B \$369.00 trigger, 0-10MHz. ALIGNMENT SCOPE OS-7001A \$369.00 0-200KHz

### AM/FM STD SIGNAL GEN.

SG-4110A \$1799.00  
Freq: 100KHz-110MHz  
Display: 6-digit LED  
Accuracy: ±(5x10-5 ± 1 count)  
Resolution: 100Hz (100-34.99MHz); 1KHz (35MHz-110MHz). Output: -19dBu, -9dBu, 1dB steps. Impedance: 50Ω VSWR 1.2

### NTSC TV COLOR BAR PAT. GEN.

CPG-1366A \$159.95  
VHF NTSC;  
Freq.: 45.75, 175.25, 187.25 MHz;  
RF Output: 10mV.  
Impedance: 75 Ohm;  
Video Output: BNC, 1Vp-p

### SWR/RF/mW POWER METER

310 \$89.95  
Freq. Range: 1.8-150MHz.  
RF Power: 0.4W/20W/200W  
SWR Measure: 1.0 - ∞ 4W min.  
Accuracy: 5%+10%; SO-239 plugs.  
Insertion Loss: 0.3dB.

Input/Output Imp.: 50Ω.  
320 \$89.95, 130-520MHz.  
330 \$119.95, 1.8-520MHz.  
SWR-3P \$26.95 1.7-150MHz.  
RF Power: 0.5-10W, 0.5W-100W.  
SWR-2 \$22.95, 1.7-30MHz; RF Power: 0.5-10W.

### mW RF Power Meter

340 \$219.00  
1.8-500MHz; RF power: 20mW/200mW/2W; Imp.: 50Ω.  
Accuracy: +10% full scale; N-type connector, SWR <1.15

### VHF/UHF ATTENUATORS

RT-8815 \$199.00, VHF, 500MHz, 81dB, 50Ω, 0.5W.  
RT-8815U \$359.00, UHF, 950MHz, 81dB, 50Ω, 0.5W.  
RT-8817 \$199.00, VHF, 500MHz, 81dB, 75Ω, 0.5W.  
RT-8817U \$359.00, UHF, 950MHz, 81dB, 75Ω, 0.5W.  
085E-2 \$499.00, UHF, 950MHz, 61dB, 50Ω, 0.5W.  
087E-2 \$499.00, UHF, 950MHz, 61dB, 75Ω, 0.5W.

### ON SALE - DC Power Supply

8102 \$599.95 \$359.95 triple outputs, 0-30V/0-3A x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage (CV) & constant current (CC), Slave/Master, Serial/Parallel connection. PS-303D \$314.95 \$282.95 dual outputs/tracking, CC&CV. Limited quantity. Full one year warranty.

### RF SIGNAL GENERATOR



SG-4162AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see SG-4160B.

### SG-4160A \$159.95

100KHz-150MHz up to 450MHz on 3rd harmonics; 6 ranges; AM modulation. RF Output: 100mVrms to 35 MHz. Modulation: Int. 1KHz AM, Ext. 50Hz-20KHz AM. Audio Output: 1KHz, 1Vrms.

### AG-2601A \$124.95

10Hz-1MHz, 5 ranges; Output Level: sinewave 0-8Vrms, square 10Vp-p. Output Impedance: 600 Ohm. Distortion: <0.05% 500Hz-50KHz, <0.5% 50KHz-500KHz.

AG-2603AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see AG-2601A above.

### FUNCTION GENERATOR



### FG-2100A \$169.95

0.2Hz-2MHz in 7 ranges; Sine, Square, Triangle, Pulse & Ramp. Output: 5mVp-p-20Vp-p, 1% distortion. VCF: 0-10V control freq. to 1000:1.

FG-2102AD \$229.95 generates signals same as FG-2100; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy

FG-2020B \$159.00 0.5Hz-500KHz, Sine, Square, Triangle. (FG)2103 \$329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. Operating Mode: sweep, AM, gated burst, VCG.

Freq. Counter: Int. 0.5Hz-5MHz, Ext. 5Hz-10MHz. FG-513 \$719.95, Digital sweep generator, Sine, Square, Triangle, Pulse, Ramp, TTL & DC, 2Hz-1.3MHz in 7 ranges, ±(0.1%+1dgt.). Freq. Counter & TCXO. 5Hz-100MHz, 6 digits x1 & x2 attnm.

### FM STEREO MODULATOR

#### AG-2011A \$549.00

#### RF SECTION:

Carrier: 98MHz ±2MHz; Output: 10mV, 1mV & 0.1mV

#### COMPOSITE SIGNALS:

Pilot: 19KHz ±2Hz, 0.8Vrms  
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion <5% L-R Separation: >50dB.

EXT. MODULATION: Freq.: 50Hz-15KHz

L-R Separation: >45dB 100Hz-3KHz, >35dB 50Hz-15KHz.

### AC MILLIVOLT METER

#### MV-3100A \$159.95

wide band 5Hz-1MHz, 3 scales, mV, dB & dBm, 300µV-100V in 12 ranges, 10A resolution, -70-40dB in 12 ranges, 0dB=1Vrms, 0.04Bm=0.755V, ±3% accuracy; Input impedance 10MΩ; Noise <2%; MV-3201B \$309.95 dual channels, simultaneous measurement.

### OSCILLOSCOPES

#### OS-7305B \$249.00 DC-~7MHz;

Vertical: 10mV/Div; Horizontal: 250mV/Div; 10Hz-100KHz in 4 ranges; 3" CRT; Internal and External Sync.; Input: 1MHz/35pF.

OS-7010A \$369.00 \$299.95 10MHz, 5" CRT, 10mV/cm-10V/cm, 1MΩ.

OS-622B \$344.95 20MHz dual trace

OS-653 \$699.95 50MHz dual, delay sweep, ALT trigger, TV syn.

OS-6101S \$1499.95 100MHz, 4ch/8trcs, delay sweep, cursor readout

### DIGITAL MULTIMETER

DMM-120 \$24.95, 3 1/2 digit, 600VDC/AC, 2ADC, 2MΩ, hFE/diode test.

DMM-123+Capacitance \$44.95, 3 1/2 digit, 600VDC/AC, 10ADC/AC, 2GΩ, 20pF, hFE/diode test, continuity beeper.

DMM-125 \$54.95, Autorange/Bar Graph, 600VDC/AC, 2ADC/AC, 32MΩ, beeper.

MIC-35 \$59.95, Autorange, 3 1/2 digit, LCD, 1000VDC/750VAC, 20MΩ, 20ADC/AC, diode/continuity check, data hold.

MIC-39 \$149.95, Autorange/Bar Graph, True RMS, 3 1/2 digit, LCD, 40MΩ, 40pF, 1000VDC/750VAC, 20ADC/AC, 600KHz

Freq. Counter, Data Hold, Drop-probe, Sleeping Mode, Memory, Read Functions

### GRID DIP METER

#### DM-4061 \$89.95 1.5-250MHz

6 bands; 6 plug-in coils, 2 transistor, and 1 diode.

Modulation: ±2KHz Sinewave.

Crystal Oscillator: 1-15MHz. Wave absorption meter. 9VDC battery.



### AUTO DISTORTION METER

#### DM-3104A \$79.95

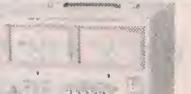
#### MEASUREMENT:

Range: 0.01%-30%, 0.1/0.3/1/3/10% full scale.

Freq.: 400Hz±10%, 1000Hz±10% (HPF).

Input: 3mV-10V, ratio measuring 20dB.

Auto. Switching Ranges: Fundamental Freq. = (f0)±10%, Fund. Rejection: >80dB at (f0)±5%, >70dB at (f0)±10%. Harmonic Accuracy: ±0.5dB, 1.8(f0)-20KHz.



### FREQUENCY COUNTER

#### FC-5250C \$119.95

Freq. Range: 10Hz-220MHz; (HF)10Hz-20MHz, (VHF)10MHz-200MHz

Gate Time: 0.1 & 1sec.

Max. Input: 10Vp-p.

Input Sensitivity: 35mV 10Hz-200MHz. Display: 7-digit LEDs.

Input Impedance: (HF) 1MΩ, (VHF) 50Ω.

FC-5260A \$146.00 \$129.95

10Hz-600MHz, 7-digit LEDs.

FC-5270 \$149.95

10Hz-1.2GHz, 8-digit LEDs.

FC-5600B \$321.00 \$299.95

10Hz-600MHz, 10-digit LEDs.



### SIGNAL TRACER/INJECTOR

#### SE-6100 \$134.95

TRACER: Gain Max. 60dB

Attenuation: 0/20/40/60dB

Input Impedance: 100KΩ

Output Imped.: 600Ω

Injector: Speaker: 8Ω

Injector: Freq.: 1KHz

Squarewave, Output Level: Continuously variable 0-4.5Vp-p

### AUTO. CAPACITANCE METER

CM3300A \$139.00 10 ranges, 99.9pF - 99.9mF, fully automatic.

Resolution: 0.1pF lowest, 0.1% full scale.

Accuracy: 0.5% of full scale+1 digit to 99.9μF, 1% of full scale+1 digit to 99.9μF.

Display: 3 digit LED.

Unit Indicator: pF, nF, μF, mF. Overrange indicator



### WOW-FLUTTER METER

#### WF-3103A \$699.95

Freq. Range: 3KHz±10%

JIS/CCIR; 3.15KHz±10% DIN.

Range: 0.03/1.1/3.3% full scale

Accuracy: ±5%

WF-3105A \$799.95, digital;

Function: LIN/WOW/Flutter/WTD.

Freq. Counter: 10Hz-9.99MHz.

Indication: CCIR/DIN/JIS



### ELECTRONIC/PC TOOL KITS

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, #0 Phillips Screwdriver, 1/8" Flat Screwdriver, Self-hold Tweezers, Metal Tweezers, Extra Parts Tube, Soldering Iron, Solder, Crimping Tool, Long-nose Plier, Cutting Plier, Zipper vinyl Case. Bits include: Phillips: #0, #1, #2, & #3; Flat: 1/8", 3/16", 1/4", 9/32", PZ1, PZ2, T8, T9, T10, T15, T20, T25, T27, T30, T40, T45; Hex: 5/64", 3/32", 1/8", 5/32", 3/16"; Sockets: 3/16" (5mm), 7/32" (5.5mm), 1/4" (6mm), 9/32" (7mm), 5/16" (8mm).

8G23 \$34.99 U.S. Patented, 23-pcs. Contents: IC Inserter, IC Tweezers, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Screwdriver, 1/8" Slotted Screwdriver, #0 & #1 Phillips, Reversible T10/T15 Bits, Reversible #2 Phillips, 1/4" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

8088 Microprocessor Trainer \$699.00 BGC-8088, teach yourself 8088 based hardware design and software programming.

9188 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

9245 \$29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with security & bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

# AMAZING PRODUCTS!



## ELECTRONIC & SCIENTIFIC DEVICES

### LASER WINDOW BOUNCE SCIENCE PROJECTS

USES SCATTERED AND DIRECT REFLECTIONS

Remarkable concept allows user to hear sounds within a premise over a beam of laser light reflected from a window or similar surface. Experimental device provides hours of interesting and educational use. Utilizes a visible red laser that simplifies alignment and discourages illegal use. Usable range will vary expect about 20 to 50 meters. Optional lens will increase range 200 to 400 meters! Further range requires expensive optics. Requires a sturdy video tripod (not incl.) Caution-check local law in your state if planning to use for accessing oral communication. **REQUIRES OPTICAL ALIGNMENT**

LWB5 Plans.....	<b>\$20.00</b>	LWB5K KIT/PLANS.....	<b>\$149.50</b>
LWB50 Ready to Use With Selected Laser Pointer.....	<b>\$199.50</b>		
LWB70 Above With High Performance Laser Gun Sight, Long Range Extender Lens and Cushioned Headsets.....	<b>\$299.50</b>		



### WIRELESS LAB KITS

ALL PARTS TO BUILD 6 EXCITING TRANSMITTER PROJECTS

- 1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
- 2 1 Mile + Telephone Transmitter
- 3 Beeper Alert for Above Telephone Transmitter
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Transmitter Rebroadcasts Video or Audio Outputs
- 6 Short Range TV/FM Disrupter NEAT PRANK!!! Discretion Advised

All 6 Above Kits Plus **FREE** Info Data Pack on "HELPFUL HINTS Building and Tuning" Wireless Devices  
COMBOX Kits and Plans.....**\$59.50**

### ULTRA BRIGHT LASERS

4 to 7x brighter 650-630 nm Radiation

ALL METAL CONSTRUCTION  
1 YEAR WARRANTY



LAPN65 15mw equiv 2000 ft.....**\$29.95**  
LAPN63 30mw equiv 3000 ft.....**\$69.95**

### FOCUSABLE LASER POINTER

From a Small Dot to a Large Spot  
LAPN65 Focusable Above LAPN65.....**\$39.95**

### TRANSISTORIZED TESLA COIL

TRANSISTORIZED
Turns a light bulb into a spectacular plasma display

Transmits Wireless Energy  
Noiseless Operation  
Pyrotechnic Effect  
12 VDC/5 Amps or Battery  
115 VAC Optical Converter  
Adjustable Frequency  
Control for Effect



TCL5 Plans.....**\$8.00**  
TCL5K Kit/Plans.....**\$59.50**  
TCL50 Ready to Use.....**\$99.50**  
12DC/7 12VDC@7Amps.....**\$39.50**

### CYBERNETIC EAR!

Use For Courtesy Lowering of TV Volume Control etc. Detect Rattles and Other Mechanical Abnormalities, Leaking Gases, Air, or Corona. Great Safety Aid for Shop on Job.

Enhances Most Hearing 3 to 4 Times!  
Adjustable Volume Control, fits Easily Into Either Ear. Many Many Uses!

CYBEREAR Ready to use.....**\$19.95**

### 3 MI TELEPHONE TRANSMITTER

Tunable On FM Broadcast. Excellent Telephone Project. Only Transmits When Phone is Used

WVPM7 Plans Only.....**\$7.00**  
Uses Readily Available Parts and Pieces

### ELECTRIC CHARGE GUN WITH 15 FOOT RANGE!!

Stuns and Immobilizes  
Attackers From a Distance.  
More Knockdown Power  
than a Handgun!  
Check Your State Legality

**FREE!! 100KV Stun Gun**  
ECG10 With STUN100.....**\$249.50**

### STUNGUNS SOLD SEPARATELY

STUN200 200KV StunGun.....**\$49.50**  
STUN300 300KV StunGun.....**\$69.50**

### INFORMATION UNLIMITED DEPT EN 1097 BOX 716 AMHERST, N.H. 03031

### JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma. Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project!! With arc control.



JACK1 Plans.....**\$8.00**  
JACK1K Kit Minus Case.....**\$129.50**  
JACK10 Ready to Use.....**\$249.50**  
12KVGEN20 Pwr Supply Only.....**\$99.50**  
12KVGEN2K Kit of Pwr Supply.....**\$79.50**

### 250KV TESLA COIL

10-14" of Explosive Bolts of Lightning

Transmit Wireless Energy  
Strange and Bizarre pyrotechnic effects.  
Ion Motors Anti-Gravity  
Size 20" H x 8" Sq  
Weight - 25 Pounds  
115 Volts/2 Amps AC  
Labelled "Use Caution"



BTC3 Plans.....**\$15.00**  
BTC3K Kit/Plans.....**\$349.50**  
BTC30 Ready to Use.....**\$449.50**  
BTC4 Plans, 500kv Unit.....**\$20.00**

### HIGH CRIME AREA SECURITY!

### INFINITY+ TRANSMITTER

ROOM MONITOR/ LINE GRABBER/CONTROLLER

- MONITOR YOUR PREMISES Avoid Ambushes and Break-ins
- ACCESS ON GOING CALLS Long-Handed Teenager!
- CONTROL 8 APPLIANCES Remote control your home!!
- EXTRA ADDED FEATURE!! The Smart Phone! HUNGARIAN Code Made From Roy Phant

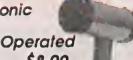


TELCON3 Plans.....**\$10.00**  
TELCON3K Kit/Plans.....**\$99.50**  
TELCON30 Ready to Use.....**\$149.50**

Programmed With built in BEEPER ALERT

### PHASOR BLAST WAVE PISTOL

130 db of Directional Sonic  
Shock Waves Energy  
Handheld and Battery Operated



PPP1 Plans.....**\$8.00**  
PPP1K Kit/Plans.....**\$49.50**  
PPP10 Ready to Use.....**\$79.50**

### ATTENTION!

HIGH VOLTAGE EXPERIMENTERS

Battery Powered Mini Sized  
Modules for research in:

HOVERCRAFT, ION GUNS  
FORCE FIELDS, SHOCKERS etc

MINIMAX4 4KV@10ma.....**\$19.50**

### BURNING LASER RAY GUN

UTILIZES LOSSLESS ENERGY CHARGING



All Parts Available  
LAGUN2 Plans.....**\$20.00**

### BURNING CO2 BENCH LASER

HOTTER THAN MOST TORCHES!



All Parts Available  
LC7 Plans.....**\$20.00**

### KINETIC ELECTRIC GUN

PIONEER A FUTURISTIC WEAPON!



PROTOTYPED IN OUR LABS Handheld Battery Operated Labeled A Danger product

EGUN1 Plans with Parts List.....**\$20.00**

All Parts are Individually Available

### 3 Mi FM BC TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert! Uses FM Table Top Radio.



FMV1K Kit/Plans.....**\$39.50**

### ION RAY GUN PROJECTS ENERGY!

Star Wars Technology Demonstrates Weapons Potential!



IORG7K Kit/Plans.....**\$99.50**

### ATTENTION!! RAILGUN EXPERIMENTERS

### HIGH ENERGY PULSER

EXPERIMENTORS AND RESEARCHERS

RAIL GUN, COIL GUN, EXPLDING WATER, ANTI GRAVITY, MASS WARPING, LEVITATION, PLASMA PROPULSION, LATTICE SNAPPING, EMP etc

- Lossless Energy Charging

Programmable Voltage to 2 KV

and Energy Control to 3 KJ

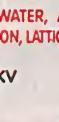
Triggered Spark Switch (IKJ)

Universal 12 VDC or 115 VAC

7.5 X 7.5 X 7" Light weight



HEP3 Plans High Energy Pulser/Ignitor



HEP3K Kit/Plans (Minus Energy Storage)



HEP30 Assembled (Minus Energy Storage)



HEPCAP 800 Joules Energy Storage

HOTSHOT

\$15.00

\$199.50

\$299.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

\$199.50

&lt;p

# ALL ELECTRONICS

C O R P O R A T I O N

## Equipment Knob

Alcoknob # PKG90B1/4  
0.86" dia. X 0.56" black molded phenolic knob with brushed aluminum face. Ribbed body with indicator line. Brass insert with two set screws. Fits 1/4" full round shaft.



CAT# KNB-74

**2 for \$1.50**

25 for \$16.25  
100 for \$50.00

## Ferrite Bead

TDK # HF70RH 16X28X9  
1.1" x 0.63" od x 0.35" id.

CAT # FB-24 \$1.00 each  
10 for \$8.50 - 100 for \$70.00



## "Hi-8" Video Cassette

SONY Hi-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box.



CAT # VCU-8

**\$3.00**  
each

10 for \$28.00  
100 for \$250.00

## S-VHS Tape (Used)



Super VHS tape users! Save a bundle on name-brand S-VHS, T-120 tapes. These tapes were used for a brief period, then bulk erased.

The record-protect tabs have been broken out, so you will have to cover the notch with a piece of tape, but they work great and cost a fraction of the "new" price. Try some, you'll be back for more.

CAT #S-VHS

**\$3.00**  
each

10 for \$28.00 • 100 for \$250.00

## ORDER TOLL FREE

MAIL ORDERS TO:  
**ALL ELECTRONICS CORP.**  
P.O. BOX 567  
VAN NUYS, CA 91408-0567

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

**MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.**

QUALITY  
PARTS

FAST  
SHIPPING

DISCOUNT  
PRICING

CALL, WRITE, FAX  
or E-MAIL For A  
**Free 96 Page  
CATALOG.**

Outside the U.S.A.  
send \$3.00 postage.

## Yellow Ultra-Bright 6,000 mcd LED

Designed for use in outdoor signs, automotive and other lighting. Bright yellow beam looks a lot like light from standard incandescent lamp. Toshiba # TLYH180P (U2) 5 mm, T 1 3/4 yellow LED. Water-clear in off-state.

CAT # LED-44

**2 for \$1.20**

10 for \$5.00  
100 for \$45.00  
1000 for \$400.00

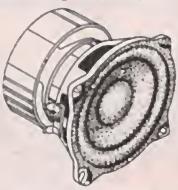


## Shielded Woofer

Designed for use in Infinity center channel video sound systems. These well constructed woofers have shielded magnets to prevent interference with picture quality.

**5 1/4" 6 OHM**

1" voice coil. 8 oz. magnet. 50 watts max power. 3.125" deep.



CAT # SK-7346

**\$10.00**  
each

12 for \$96.00

## Low Power Audio Amp

Motorola MC34119P

Low power audio amplifier suitable for speaker phones or talking picture frames. The 8 pin DIP package requires only a few additional parts, operates on 2 - 16 volts and drives speakers of 8 ohms or greater. Output power exceeds 250 mW with 32 ohm speaker. Power-down option saves power in battery driven applications. Hook-up sheet.

Large quantity available.



CAT # MC34119P

**50¢**  
each

50 for \$20.00  
500 for \$150.00

## 3 Volt Lithium Coin Cell with PC Leads

Panasonic # BR2330-1GU

3 volt, 255 mAh coin cell. Lithium batteries have a very long shelf life and are great for memory back-up protection. 0.9" diameter x 0.12" thick. 0.7" between positive and negative pc leads.



VERY SPECIAL PRICE  
LARGE QUANTITY AVAILABLE

CAT # LBAT-16

**2 for \$1.50**

20 for \$12.00  
100 for \$45.00  
1000 for \$300.00

## Miniature Temperature Sensor (THERMISTOR)

Keystone (Similar to #RL0503-17-56K-96-MS) 30K ohms @ 25 degree C. (77 degree F.) Negative temperature coefficient. 0.2" long X 0.09" diameter, epoxy insulated bead. 1.13" long teflon insulated AWG#30 wire leads. Prepped with 0.75" long metal tabs.

CAT# THR-19  
**2 for \$1.50**

box of 264  
\$150.48  
(57¢ each)



1-800-826-5432

FAX (818) 781-2653 • INFO (818) 904-0524

INTERNET <http://www.allcorp.com/>

E-MAIL [allcorp@allcorp.com](mailto:allcorp@allcorp.com)





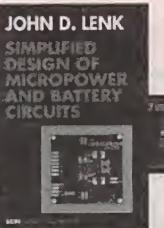
Key Titles from...



**Newnes**

An imprint of Butterworth-Heinemann

Buy more  
than 1 book  
and take 15%  
off total order



**Simplified Design  
of Switching  
Power Supplies**

by John D. Lenk

1996 • 225pp • pa •  
0-7506-9821-7 • \$29.95

**Simplified Design  
of IC Amplifiers**

by John D. Lenk

1996 • 240pp • pa •  
0-7506-9508-0 • \$29.95

**Lenk Series**

**Simplified Design  
of Voltage-Frequency  
Converters**

by John D. Lenk  
September 1997 • 304pp •  
pa • 0-7506-9654-0 • \$29.95

**Simplified Design  
of Data  
Converters**

by John D. Lenk  
April 1997 • 242pp • pa •  
0-7506-9509-9 • \$29.95

**Simplified Design  
of Linear Power  
Supplies**

by John D. Lenk

1996 • 246pp • pa •  
0-7506-9820-9 • \$29.95

**Simplified Design  
of Micropower and  
Battery Circuits**

by John D. Lenk

1996 • 240pp • pa •  
0-7506-9510-2 • \$29.95

**Audio Power  
Amplifier Design  
Handbook**



**More Books from Newnes**

**PCB Design  
Using  
AutoCAD**

by Chris Schroeder  
Aug 1997 • 336pp  
• pa • 0-7506-9834-9  
• \$44.95

**Understand  
Electronic  
Filters**

by Owen Bishop  
1996 • 180pp • ha •  
0-7506-2628-3 •  
\$26.95



**Inside PC Card**



by Faisal Haque  
1996 • 352pp • ha •  
0-7506-9747-4 •  
\$52.95

**Audio Power  
Amplifier  
Design  
Handbook**

by Douglas Self  
1996 • 256pp • pa •  
0-7506-2788-3 •  
\$34.95

**High  
Performance  
Audio Power  
Amplifiers**

by Ben Duncan  
1996 • 288pp • ha •  
0-7506-2629-1 •  
\$59.95

**Digital Storage  
Oscilloscopes**

by Ian Hickman  
1996 • 208pp • pa •  
0-7506-2856-1 •  
\$39.95



Please send me the book(s) listed below. (Buy more than one, and take 15% off the total order.)

Write book number(s) here:


Mail your order to: Butterworth-Heinemann, Fulfillment Center, 225 Wildwood Ave., Woburn, MA 01801 USA

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

E-mail \_\_\_\_\_

Please send me a free Newnes catalog, Item #645.

Phone: 1-800-366-BOOK      Fax: 1-800-446-6520

E-mail your order to [orders@repp.com](mailto:orders@repp.com)

I have enclosed a check for \$ \_\_\_\_\_  
 Please charge my: \_\_\_\_\_

Visa     MasterCard     American Express

Card no. \_\_\_\_\_ Exp. date \_\_\_\_\_

Signature \_\_\_\_\_

**U.S. Customers:** Please add \$4.00 handling fee for the first item ordered, \$1.50 for each additional item, to all check and credit card orders. Billed orders will be charged additional shipping based on weight and destination. All U.S. orders must include your state sales tax. Prepayment or company purchase order is required for all orders. Prices subject to change without notice.

**Canadian Customers:** Please pay by credit card or in U.S. funds and include 7% GST on books and handling.

**European Customers:** Add £2.00 UK and surface postage.  Check for Air Mail; extra cost will be charged.

 A member of the Reed Elsevier plc group

TS232

Visit our web site: <http://www.bh.com/newnes>

**"Get the skills you need at a price you can afford!"**

# Earn up to \$45 an hour or more as a skilled Computer Programmer.

Cash in on the explosion of opportunities. Start your new career or even open a business of your own as a highly-paid computer programmer.

Computer programmers today can almost write their own ticket to financial well-being and job satisfaction. Only Foley-Belsaw's unique in-home training programs can give you the skills you need at a price you can afford.

You'll learn the three hot computer languages — QBasic, C and Visual Basic. You'll even work with the hot new C++. With this easy-to-learn knowledge, you'll write your first QBasic program by the end of the first SkillPak of lessons. Soon you'll be programming sound and graphics, and even learning how to program for the Windows environment — the most popular application program today.

## It's easy to cash in!

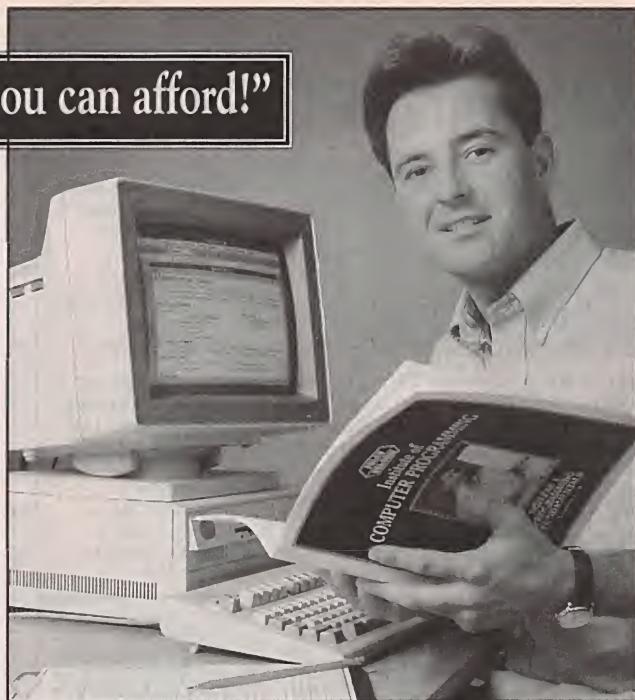
Look at some of the things professional computer programmers do. "Wrote a C program to clean up a WordPerfect file; edited the resulting file as data errors were found." This work would take a trained programmer less than five hours to complete, and they could make over \$200 for the work. That's money you could be making — and soon — with training from the Foley-Belsaw Institute of Computer Programming.

## Everything is included!

We provide you with all the materials you'll need to become a professional computer programmer. You'll receive 37 lessons, designed for you by the Foley-Belsaw Professional Programmer Staff. Other valuable materials include a *Programmer's Handbook*, *Programmer's Examples* on two 3.5 inch disks, *Programmer's Flowchart Template*, and a booklet, *Selecting the Right Computer*.

Other schools force you to buy a complete computer package as part of their training program. At Foley-Belsaw we understand that your needs as a programmer may not fit into a "one size fits all" approach. Why should you pay hundreds of dollars for a computer system that you may not need?

We'll tell you what you need to know so that when you're ready to buy your own computer, you can get the machine that fits your needs at the lowest possible price. That's the Foley-Belsaw way.



## Get the free facts today.

Whether you want to change careers, have a profitable part-time job or start your own business, Foley-Belsaw Institute's new computer programming course is the first step. A profitable future in computer programming can be yours. Call or write today for a fact-filled information kit including a free copy of *Computer Programming — A Profitable Career In Your Spare Time*. See how easy it is to begin a money-making career as a sought-after computer programmer. Our free full-color information kit outlines the steps of the computer programming course and shows you everything you will receive as part of your training.



Mail this coupon or call today

Toll Free 1-800-487-2100!

Your free opportunity kit will be rushed to you!

If coupon is missing, write to: Foley-Belsaw Company, 6301 Equitable Road, Kansas City, MO 64120

Call or complete & return this coupon to: Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120

**YES!** Rush me a free information kit on Computer Programming right away. Dept. 35480

*Other career courses:*

- Locksmithing, Dept. 13065
- Small Engine Repair, Dept. 52941
- Saw & Tool Sharpening, Dept. 21877
- VCR Repair, Dept. 62761
- Computer Repair, Dept. 64663
- TV/Satellite Dish Repair, Dept. 31533
- Gunsmithing, Dept. 92569
- Woodworking, Dept. 43809
- Upholstery, Dept. 81479
- Vinyl Repair, Dept. 71409
- Electrician, 95342
- Computer Specialist, Dept. 38309
- Networking Specialist, Dept. 39296

I understand that there is ABSOLUTELY NO OBLIGATION and NO SALESMAN WILL CALL.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



PC  
PLACE

# 386 MINI-PC \$83

1K PRICE  
EVAL \$295  
8088 \$27



includes:  
 -5 Serial, 3 Parallel (32bit max)  
 -Up to 8 meg ROM (27C080)  
 -32k RAM exp. to 64Mbyte  
 -Battery backed RT Clock  
 -LCD and Keyboard ports  
 -IRQ x15, DMA x2, TIMER x4  
 -On-board LED display  
 -Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

## A to D D to A CONVERTERS

For PC or SBC  
8,12,16 bit resolution  
up to 24 channels  
starting at \$21 OEM (1k)  
eval kit \$75



## \$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM up to 8 meg (27C64-080). Adapters for micros, PLCC, etc. Parallel port version for notebook. FAST AND EASY TO USE.

LOW COST... LOW POWER...

## LOW RISC!

QTY 1K PRICE  
**\$1.99**  
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER  
 COMPARE: 16C54 MV1200  
 OEM (1K) PRICE \$2.57 \$1.99  
 RS232 PROGRAM DOWNLOAD NO YES  
 SINGLE CHIP OPERATION NO YES  
 BUILT-IN BASIC NO YES  
 EEPROM DATA MEMORY NONE 64  
 PROGRAM MEMORY 768 OTP 1K FLASH  
 MATH REGISTERS 1 32  
 MAX INSTRUCTIONS / SEC 5M 20M  
 MAX COUNTER BITS 16 18  
 INPUT / OUTPUT BITS 12 15  
 A TO D COMPARATOR NO YES  
 HARDWARE INTERRUPTS NONE 3  
 - LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -

		PINOUT:	
RESET	1	20	VCC
PD0	2	19	PB7
PD1	3	18	PB6
XOUT	4	17	PB5
XIN	5	16	PB4
PD2/INT	6	15	PB3
PD3	7	14	PB2
PD4/TMR	8	13	PB1/AD1
PD5	9	12	PB0/AD0
GND	10	11	PD6



**PC SOLID STATE DISK**  
**\$21** OEM (1k) eval kit 75.00  
FLASH / RAM / EPROM  
256K-16M PCMCIA/DIPS

No More Hangups...

**PC WATCHDOG!**  
Reboots PC OEM \$21 EVAL \$75



**VGA LCD** 640x480 controller for PC or SBC  
\$27 oem \$95 eval combo LCD/CRT version available



visit our web site: [www.star.net/people/~mvs](http://www.star.net/people/~mvs)

MVS BOX 850  
MERRIMACK, NH 03054  
(508) 792-9507



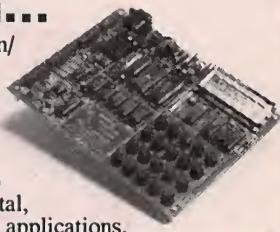
5yr Limited Warranty  
Free Shipping  
Hrs: Mon-Fri 10-6 EST

CIRCLE 323 ON FREE INFORMATION CARD

## Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/embedded control system. Extensive manuals guide you through your development project. All programming and hardware details explained.

Complete schematics. Learn to program the LCD, keypad digital, analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

• 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.  
Money Back Guarantee

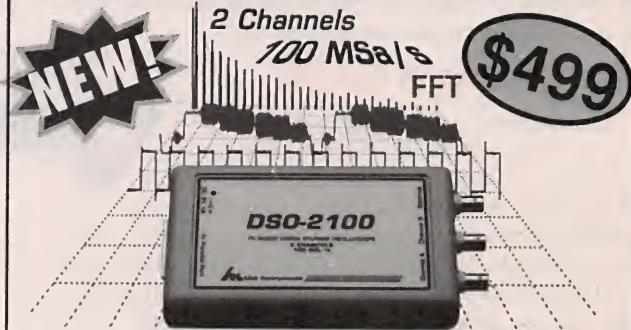
Call for Free Info Pack, or see  
WEB at <http://www.aesmicro.com>  
714-550-8094, FAX 714-550-9941



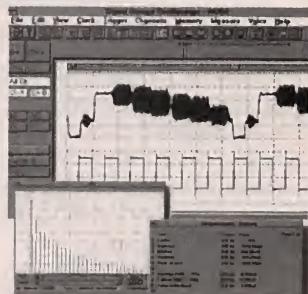
Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

## Digital Oscilloscope 100 MSa/s



- 2 Ch. Digital Oscilloscope
- 100 MSa/s max single shot rate on both channels
- 32K samples per channel
- Advanced Triggering
- Easy to use Windows and DOS software included
- Small and Lightweight (9 oz and 6.3" x 3.75" x 1.25")
- Parallel Port interface to Laptop or Desktop PC
- Optional FFT Spectrum Analyzer, Advanced Math and TVLine Trigger.



For \$499 you get the model DSO-2102S Oscilloscope, Probes, Interface Cable, Power Adapter, and Windows and DOS Software.



**Link Instruments (973) 808-8990**

369 Passaic Ave. • Suite 100 • Fairfield, NJ 07004  
[www.LinkInstruments.com](http://www.LinkInstruments.com) • Email: [Sales@LinkInstruments.com](mailto:Sales@LinkInstruments.com)

## MEMBRANE SWITCH KITS!

FLAT PANEL KEYPADS  
ASSEMBLE IN  
MINUTES WITH YOUR  
LEGEND

AVAILABLE IN 4, 12,  
16, 24 & 40 KEY TYPES



DSK-4  
\$9.89

DSK-12  
\$14.29

## INDUSTRIAL TYPES AVAILABLE

MORE THAN 30 LAYOUTS  
TO FIT MOST  
APPLICATIONS

CALL FOR FREE  
BROCHURE

## SIL-WALKER

880 CALLE PLANO,  
UNIT N  
CAMARILLO, CA  
93012

PHONE: (805) 389-8100

FAX: (805) 484-3311

VISA / MASTERCARD

©1994 EDF

Buy recycled.



It would mean  
the world to them.

Recycling keeps working to protect  
their future when you buy products  
made from recycled materials. For  
a free brochure, write *Buy Recycled*,  
Environmental Defense Fund, 257  
Park Avenue South, New York, NY  
10010, or call 1-800-CALL-EDF.



## Modern computing and standard surge suppressors...a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments.

Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. (See *five things you probably don't know about your surge suppressor* at [www.fivethings.com](http://www.fivethings.com).)

**THE POINT:** Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; *modern computers are much more sensitive and susceptible to powerline anomalies*.

## INTRODUCING BRICK WALL SURGE FILTERS...

### The World's Best Surge Suppressor

*Initially engineered for critical, non-fail industrial applications, this patented device protects indefinitely and sets a new standard for every measure of surge suppressor and powerline filtering performance.*

A Brick Wall 1) Utilizes NO MOV'S or Any Other Sacrificial Components (two pound inductor and nine capacitors are the heart of the unit) 2) Has No Joule Rating or Surge Current Limitations 3) HAS BEEN TESTED AND CERTIFIED BY UL TO THE MOST DEMANDING CLASSIFICATION OF A NEW GOVERNMENT SPECIFICATION; CLASS I, GRADE A. Which Means: UL PUT ONE THOUSAND 3000A, 6000V SURGES (this is the largest surge an interior environment can experience) THROUGH A UNIT (at 60 second intervals) AND DOCUMENTED NO FAILURE OR PERFORMANCE DEGRADATION OF ANY KIND WHATSOEVER..

### i.e.: A Brick Wall Will Not Fail.

*We know of no cord connected, MOV based surge protection device that has, or can pass this test.*

A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, UL NEVER SAW THE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE. Once again, we know of no other surge protection device that could come close to this performance level.

A Brick Wall is a current activated Series Mode device. Since it is not wired in parallel, nor voltage activated, it does not have to wait for the capacitors of the power supply to charge before it becomes effective. YOUR EQUIPMENT IS PROTECTED INSTANTANEOUSLY (and indefinitely).

These devices were engineered utilizing a current limiting/surge filtering technology. THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.

#### Powerline Filtering

In addition to all this, Brick Wall Surge **FILTERS** are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.

### You Can't Buy a Better Surge Protection/Powerline Filtering Device...Anywhere.



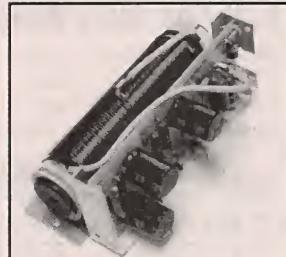
®  
BRICK WALL DIV.,  
PRICE WHEELER CORP.  
**1-800-528-0313**

Fax: 1-800-528-6623 E-Mail: [info@brickwall.com](mailto:info@brickwall.com)

Web: [www.brickwall.com](http://www.brickwall.com)

Visa - MC - AMEX

ASK ABOUT OUR NEW IN-LINE UPS/SERVER PROTECTOR



Available in Modular Form

PC  
PLACE

March 1998, Electronics Now

## Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

### Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Digital Filtering
- Triggering, Decimation
- Transfer Functions, Coherence
- Dynamic Data Exchange (DDE)
- Time Series, Spectrum Phase, Spectrogram and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

### Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

### System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

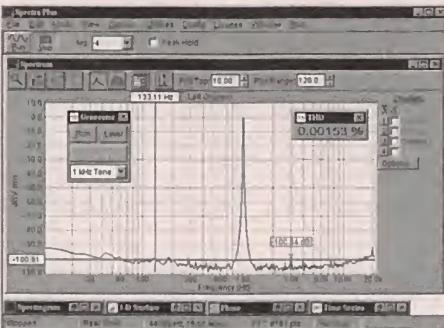


Pioneer Hill Software  
24460 Mason Rd. N.W.  
Poulsbo, WA 98370

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: [pioneer@telebyte.com](mailto:pioneer@telebyte.com)



## Priced from \$299

(U.S. sales only – not for export/resale)

Professional Quality Sound Cards Available...Call

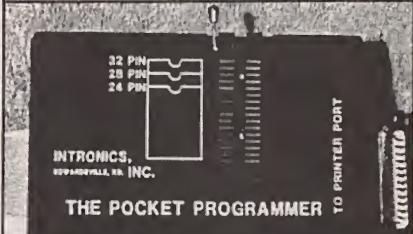
### DOWNLOAD FREE 30 DAY TRIAL!

[www.telebyte.com/pioneer](http://www.telebyte.com/pioneer)

### Spectra Plus 4.0

Affordable Signal Processing Software

## The Pocket Programmer Only \$129.95



The portable programmer that uses the printer port of your PC instead of an internal card. Easy to use software that programs Eprom, EEprom, Flash & Dallas Ram. 27(C) / 28(C) / 28F / 29F / 29C & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, PLCC, 5-Gang, 874X, 875X MCU's, 40-Pin X 16 & Serial Eprom's, and Eprom Emulator to 32K X 8.

Same Name, Address & Phone # for 13 Years... Isn't it Amazing?

### Intronics, Inc.

Box 13723 / 612 Newton St.  
Edwardsville, KS 66113 Add \$4.75 COD  
Tel. (913) 422-2094 Add \$4.00 Shipping

Fax (913) 441-1623 Visa / Master Charge

## New and Pre-Owned Test Equipment



### Goldstar



Model OS-9100P → \$899.00

### Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty



**BK PRECISION**  
MAXTEC INTERNATIONAL CORP. Model 4040 \$499.00  
20 MHz Sweep/Function Generator

- 0.2 Hz to 20 MHz, 5 digit LED Display
- AM & FM Internal or External Modulation
- Sine, Square, Triangle, TTL, CMOS Outputs
- Burst Operation
- External 30 MHz Frequency Counter

**NEW!**

### Pre-Owned Oscilloscope Specials

B + K Precision 1476 10 MHz \$229.00  
Great Starter Scope!

Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$699.00
Tektronix 475	200 MHz	\$799.00
Tektronix 475A	250 MHz	\$899.00

- The Industry Standard of Oscilloscopes
- Dual Channel, Calibrated Delayed Sweep
- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- 6 Month Warranty - The Longest Available!

### LOWEST PRICES EVER!

NEW FLUKE MULTIMETERS & TEKTRONIX OSCILLOSCOPES

The Industry Standard in Multimeters

Fluke Model 87 ..\$285.00

TEKTRONIX TDS SERIES  
ON SALE!

See us on the Web!  
[www.fotronic.com](http://www.fotronic.com)

1-800-996-3837

**TOLL FREE 1-800-99-METER**

## Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

P.O. BOX 708 Medford, MA 02155

(617) 665-1400 • FAX (617) 665-0780

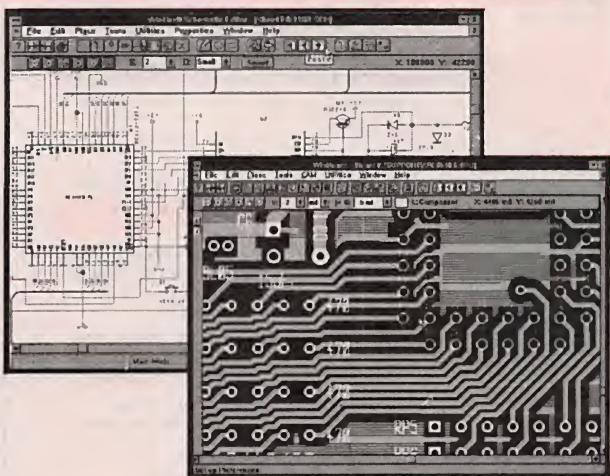
email: [afoti@fotronic.com](mailto:afoti@fotronic.com)

# Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

## WinDraft® Schematics

- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.



## WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique **pin capacity** versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

### WinDraft 2.0 Available Now

CIRCLE 319 ON FREE INFORMATION CARD

**\$ 250** WinDraft or WinBoard - P650  
**\$ 495** WinDraft or WinBoard - unlimited  
**\$ 895** WinBoard P650 with CCT Specctra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ivex. Your satisfaction is guaranteed!

**World Wide Web:** <http://www.ivex.com>

Information and free evaluation version is available on the Ivex WW Web, FTP and BBS.

**Tel:** (503) 531-3555  
**Fax:** (503) 629-4907  
**BBS:** (503) 645-0576



Ivex Design International. 15232 NW Greenbrier Parkway. Beaverton, Oregon 97006. USA.

ADV2\_1

### RAIN FOREST RESCUE: TO HELP SAVE THE BIRDS OUTSIDE YOUR WINDOW

Support Rain Forest Rescue. Help put a stop to the destruction of the planet's rain forests.

To contribute to  
Rain Forest Rescue, call  
1-800-222-5312

 The National Arbor Day Foundation

### MEREDITH INSTRUMENTS

5420 W. Camelback Rd #4  
Glendale, AZ 85301  
(602) 934-9387

Check out our complete line in our  
Free catalog on Lasers and Optics

<http://www.mi-lasers.com>



**New Visible Laser Diodes**  
**\$10.00**



**New He-Ne tubes from**  
**\$10.00**



**New Green Laser Heads**  
**\$150.00**

# The World's Largest Source for Home Automation

The Best & Most Comprehensive Home Automation Catalog in the Industry.

Best Customer Service & Technical Support

**FREE**  
128 page full color catalog!

HOME AUTOMATION SYSTEMS, INC.

Mail Your Home Sales  
Order Form Today  
for a FREE Catalog  
Order Today by Mail  
Or Call 800-762-7846

Thousands of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software, development tools, lighting control, telephone systems, security systems, surveillance cameras, infrared audio/video control, home theater, touchscreen control, HVAC, pet care automation, wiring supplies, books and videos and much more!

World's Largest Selection!

Lowest Prices Guaranteed!

HOME AUTOMATION SYSTEMS, INC.

Questions: 714-708-0610 Fax: 714-708-0614  
e-mail: catalog@smarthome.com  
www.smarthome.com

Call for a **FREE** Catalog! 800-762-7846

**800-SMART-HOME**

Dealers/Resellers ask about our  
HASPRO Dealer Program 800-949-6255

## PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILDE  
SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



CALL ADVANTECH LABTOOL 599 EETOOLS SIMMAX  
629 ICE TECH MICROV 795 CHROMA SIMM/SIP  
650 EETOOLS ALLMAX + 359 MOD-MCT-EMUPA/R  
409 EETOOLS MEGAMAX 279 MOD-MCT-EMUPA/R  
509 EETOOLS MEGAMAX4 49 EPROM 1G TO 512K  
369 XELTEK SUPERPRO II 69 EPROM 1G TO 1MEG  
409 XELTEK SUPERPRO II P 99 EPROM 4G TO 1MEG  
249 XELTEK SUPERPRO L 199 EPROM 1G TO 1MEG  
165 XELTEK ROMMASTER II 89 EPROM 1G TO 8MEG  
479 MOD-MCT-EMUPA 129 EPROM 4G TO 8MEG  
739 STAG ORBIT-32 250 EPROM 8G TO 8MEG



## General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234  
Web [www.generaldevice.com](http://www.generaldevice.com) E-Mail [icdevice@best.com](mailto:icdevice@best.com)



One tree can make  
3,000,000 matches.



One match can burn  
3,000,000 trees.



A Public Service of The Match  
Manufacturers Association

# ROBOTIC MACHINING

ROUTE, MILL, DRILL, CARVE, ENGRAVE, PAINT . . .  
IN WOOD, PLASTIC, VINYL, PC BOARD, & LIGHT METALS!

- 4 MOTOR GANTRY MILL CONFIGURATIONS
- PC COMPUTER CONTROLLED CNC/DNC
- IMPORT/ EXPORT FILES TO OTHER CADS
- AUTO-BACKLASH COMPENSATION
- PRE-MACHINED HEAVY CASTINGS
- SIMULTANEOUS 3 AXIS MOTION
- FREE 3D CAD/CAM SOFTWARE
- AVAILABLE IN KITS OR ASSEMBLED
- EXPEDITE SERVICE ALSO AVAILABLE
- OPTIONAL ALUMINUM WAY COVERS
- .001" RESOLUTION / AMERICAN MADE

<http://www.uscyberlab.com>

U.S. CYBERLAB, INC. 14786 SLATE GAP RD., WEST FORK, AR 72774

CALL NOW FOR INSTANT SPECS 501-839-8293 24 HR. FAX-BACK

# EPROM+

## A DEVICE PROGRAMMER FOR BENCH AND FIELD



SUPPORTS ALL  
STANDARD PARTS!

USES PARALLEL  
PRINTER PORT!

**FIRST GENERATION EPROMS** (24 PIN) 2708, TMS2716\*, 1702\*, 25XX

**SECOND GENERATION EPROMS** (24, 28, 32 PIN) 2716 - 27C080 (8 MEG)

**16 BIT EPROMS\*** (40, 42 PIN) 27C1024 - 27C160 (16 MEG)

**FLASH EPROMS** (32 PIN) 28F, 29C, 29EE, 29F FAMILIES PLUS BOOT BLOCK

**EEPROMS/NVRAMs** (24-32 PIN) 28C04 - 28C10, X2210/12, ERS901, 12XX

**SERIAL EEPROMS\*** (ALL 8 PIN PARTS) 17, 24, 25, 35, 59, 80011, 85, 93, ER1400

**BIPOLAR PROMS\*** (16-24 PIN) 74SXXX AND 82SXXX FAMILIES

**MICROCONTROLLERS\*** (ALL FAMILIES) 874X, 875X, 87C5XX, 87C75X, 89C5X  
89CX051 68HC705, 68HC711, PIC12XXX - 16XXX, 17C4X PLUS FLASH AND 14000

◆ READ, PROGRAM, COPY COMPARE, FILE LOAD/SAVE (PLUS MORE!)

◆ FULL SCREEN EDITOR W/25 COMMANDS + BYTE & WORD MODES

◆ SOFTWARE RUNS UNDER DOS, WIN3.1/95 ON ANY SPEED MACHINE

◆ MADE IN THE USA • 30 DAY MONEY BACK GUARANTEE \*ADAPTER REQUIRED  
DIAGRAMS INCLUDED

SYSTEM INCLUDES: PROGRAMMING UNIT, SOFTWARE, PRINTER PORT  
CABLE, PRINTED MANUAL AND POWER PACK

ANDROMEDA RESEARCH  
P.O. BOX 222  
MILFORD, OHIO 45150  
(513) 831-9708 FAX (513) 831-7562

**\$289**

\$5.00 SHIPPING • \$5.00 C.O.D.  
VISA • MASTERCARD • AMEX

Help protect our nation's soil and water.  
Call for your free action packet.

**1-800-THE-SOIL**  
WE OWE IT TO OUR CHILDREN

United States Department of Agriculture  
Soil Conservation Service

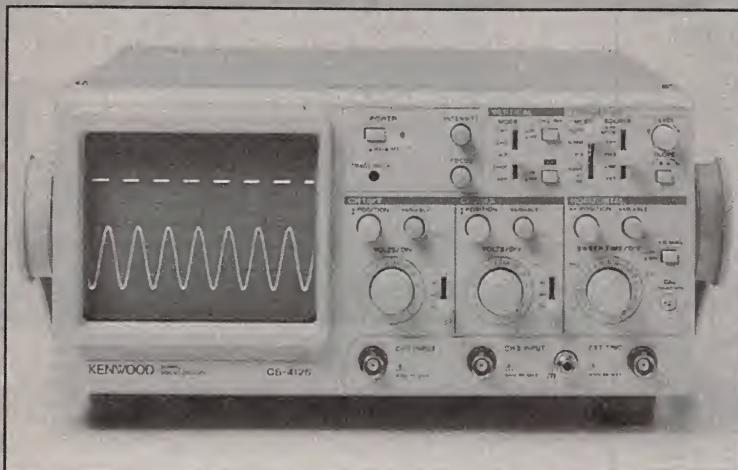


STARTING AT  
\$695.00

3 AXIS UNITS  
FROM 12" X 12" TO  
66" X 66" MACH. AREA

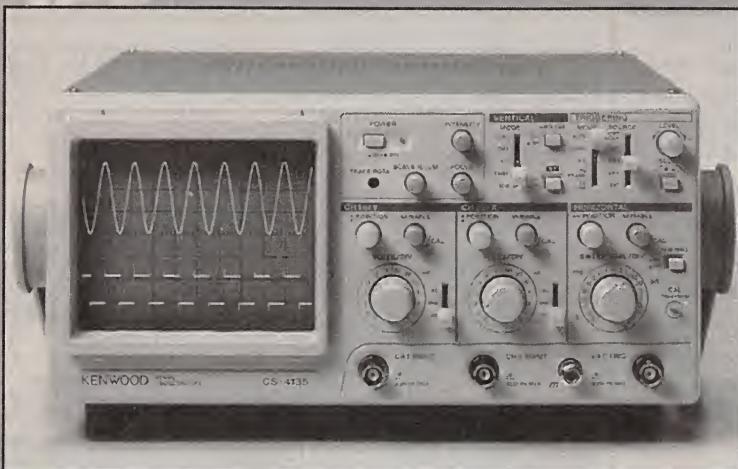
# KENWOOD

*...from the company you've  
been listening to for years...*



2-Channel, 20-MHz  
**CS-4125**

Regular \$595  
**Sale \$389**



2-Channel, 40-MHz Oscilloscope  
**CS-4135**

Regular \$855  
**Sale \$685**

*Hybrid IC Technology is the Key to the High  
Quality and High Reliability at Low Cost!*

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm ( ) including protrusion.
- WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



Call for your free 84 page test instrument catalog today!!!  
8931 Brookville Road \* Silver Spring, Maryland \* 20910

\* Phone 800-638-2020 \* Fax 800-545-0058 \* email [SMPRODINTL@AOL.com](mailto:SMPRODINTL@AOL.com)

# BLOWOUT! TIMELINE INC. BLOWOUT!

Over 11 years and 29,000 customers and still growing

## LIQUID CRYSTAL DISPLAYS

**240x64 dot LCD with built-in controller.**  
AND 4021ST-EO. Unit is EL back-lit. \$59.00 or 2 for \$109.00 or  
OPTREX. DMF5005 (non back-lit) \$49.00 or 2 for \$89.00  
20 character x 8 line 7x16 x 24H The built-in controller allows you to do text and graphics.

## Alphanumeric—parallel interface

16x1	\$7.00	20x2	\$10.00	32x2	\$8.00
16x1 (lg. char.)	\$10.00	20x4	\$15.00	40x1	\$8.00
16x2	\$7.00	24x4 (lg. char.)	\$10.00	40x2	2 for \$20.00
16x2 (lg. char.)	\$10.00	24x2	\$10.00	40x4	\$20.00
16x4	\$15.00	32x4	\$10.00	4x2	\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

## Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

**6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.00**

## LASER PRODUCTS

HeNe Laser Head (10mW max. output) TEM00, 15.5" long MFG: NEC \$89.00  
Laser Power Supply (for HeNe tube) \$79.00

### LASER SCANNER ASSEMBLY \$19.00

Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

### LASER DIODE (5mW) with collimator \$20.00

### VISIBLE LASER DIODE: 5mw at 670nm \$15.00

Index guided. Threshold current 40 ma typical.

### 3 and 4mW, 1,300nm LASER DIODES, 5.6mm package, \$15.00

Mitsubishi Electric part number ML701BIR-E21A, General specs are:

1. Vop=1.25, Beam Divergence 25.6° x 28.6°; 2. Tc=24°C, lop=19 to 20mA, IT=10.7mA; 3. Wavelength range between 1,280nm and 1,330 nm

### POLYGON MOTOR UNIT & DRIVER \$69.00

Ten-sided flat surface mirror mounted on an armature that spins at 125 revolutions per second yielding a beam sweep rate of 1250 sweeps per second. The driver for the polygon unit requires 24 volts and plus and minus 12 volts to operate. There is also an f/0.8a lens in front of the polygon scanning mechanism with a three inch diameter. Great for optical experiments, etc. Very high quality units. (Mfr: JAPAN ELECTRONICS)

## POS & BAR CODE

### MAGNETIC CARD READER \$25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300) \$25.00

## POWER SUPPLYS

### SWITCHING POWER SUPPLYS \$12.00 or 2 for \$20.00 115/230 Volts

73 WATT (2) 4 pin power connectors attached • Dim: 8.5" L x 4.5" W x 2" H

Output: +5V @ 2.9-7.5, A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A

60 WATT Dim: 8 1/2" x 4 1/2" x 3 • Output: 5V @ 6A + 12V @ 1A - 5V @ 1A - 12V @ 1A

## CHARGE COUPLED DEVICES

### "The Spy In The Sky" \$29.00

### MATRIX TYPE

Thomson 576X550 pixel CCD  
400-1,100nm resolution and responsivity. \$500.00 Original cost device

Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V) \$29.00  
Chip size 10.7 (H) x 9.3 (V) mm<sup>2</sup> • Unit cell size 23.0 (H) x 13.4 (V) um<sup>2</sup>.  
Ceramic 24 pin DIP package • Mfr: Sony, Part# 016AL

4096 element CCD \$15.00

### LINEAR TYPE

1024 element CCD \$10.00

2048 element CCD \$10.00 • 1728 element CCD \$10.00

## MISCELLANEOUS

ADAPTEC 4070A (RLL) OR 4000A (MFM), SCSI Controller, your choice \$25.00

IBM 370 option XT and AT emulation boards \$25.00

2539 W. 237th Street, Bldg. F, Torrance, CA 90505

Order desk only: USA: (800) 872-8878 CA: (800) 223-9977  
L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590

**OEM INQUIRIES WELCOME**

## MONITORS

### Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15Khz. • Ability to do 40 and 80 column.

5 inch Amber \$25.00 • 7 inch Amber \$25.00

9 inch Amber or Green \$25.00

2 for \$69.00

### 5" COLOR MONITOR \$39.00

• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible  
• 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.  
• Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr: Samtron

### 9" COLOR SVGA MONITOR \$249.00

Fully Enclosed – Tilt and swivel type.

## HACKER CORNER

### Encased Spread Spectrum RF Modem \$199.00

The ProLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmittal at rates up to 19.2 Kbaud (full duplex) over a range of 500-800 feet. Modules use 900 MHz spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (~ 4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available.

### US made Micronics 486 VLB ALL in ONE \$39.00 or 2 for \$69.00

motherboard, supports 3.4 or 5V CPU, at either 25 or 33 mhz basic clock. Can use AMD or Intel from 486SX25 thru 486DX4-100 or HOT new AMD 5X86-133 cput. On board SVGA video. On board 1 meg video ram expandable to 2 meg with ATI Mach 2 chip set. On board 2 high speed serial ports, 1 printer port, floppy and IDE hard drive controller. On board 256K cache. Uses 72 pin simm memory. Landmark speed rating of 479 with AMD chip.

Board will not fit standard ALL in One case because of non standard location of riser board. VLB riser board is included with motherboard.

### COLOR CCD CAMERA \$149.00

• 12 VDC • 1/3-inch, CCD area image sensor • 514 (horizontal) x 491 (vertical) • 2:1 interlaced • 15.73 kHz (horizontal), 59.94 Hz (vertical) • 330 horizontal and 350 vertical lines • 10lx • 1V, NTSC signal format • Lens: 1/3-inch, fixed focus (F:2.8, F5.6) • Dimensions: (W) 67 (2.63) x (H) 34 (1.45) x (D) 112.6 (4.43)

### SONY Miniature Color LCD Display (LCX005BKB) \$29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

### CELL SITE TRANSCEIVER \$49.00 2 for \$89.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 15 watt modulated signal to drive an external power amplifier, channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

### Encased Black & White Composite CCD Camera with Adapter

IR viewing to 1000 nm 7 1/2 L x 2 1/2 W x 1 1/4 H

Comes complete with CCD camera, mounting nut on bottom of casing.

12VDC power supply. Excellent low light capability, standard RCA NTSC video out.

\$89.00

Great for: entryway security/remote monitoring, video conferencing/desktop video conferencing

2 for \$159.00

This miniature camera is perfect for multimedia computer applications as well as security and surveillance. NTSC output allows use with all popular video digitizing boards for Apple Macintosh and Microsoft video for Windows. Connects directly to any composite monitor or VCR with "video" input. The razor-sharp wide-angle lens focuses from two inches to infinity and its state-of-the-art CCD technology accurately captures 16 level grayscale images for Quick Time movies and still pictures. Records at 30 frames per second and 260 lines resolution with excellent low light capability. Uses 12VDC (adapter supplied) and standard RCA cable.

### POINT OF SALE BANK TERMINAL \$39.00 or 2 for \$69.00

• LCD Display 20 Char. x 4 Line • Printer 16 Column Dot Matrix - Epson • 24 Key Domed Membrane Keypad • Intel 80C32 Processor • 2 PCMCIA Sockets (ICL Slots) • Dallas 18S128 Realtime Clock • 2 Solid State Buzzers (Piezo Electric) • 4 Cents • Rockwell Modem Chip • Telephone Line Interface (4 Pin "RJ" Connector) • RS-232 Interface (8 Pin "D" Connector) • 1LC40 Battery Pack Inside

Note: We have not been able to get an access code in the software. Thus, while time of day and other introductory things are displayed on LCD, the original capabilities of this unit cannot be guaranteed. Also, we do not have a source for the small cards that were to go in the PCMCIA sockets. Requires 12 volt adapter for power. (Not included) Dimensions: 9-1/2L x 6-1/4W x 2-1/2D • Original cost over \$450.00

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

OVER  
30,000  
ITEMS  
IN STOCK

# Dalbani®

The Ultimate Saving Source

**LARGE VARIETY  
SAME DAY SHIPPING**

*Over 6,000 new items*

**Audio/Video Service Parts**

**Audio/Video Accessories**

**Professional Audio**

**Security Products**

**Connectors**

**Technician Aids**

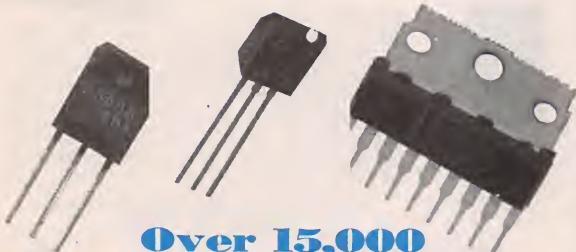
**Chemicals**

**Test Equipments**

**Soldering Equipment**

**Automotive Products**

**Automotive Installation Kits**



**Over 15,000  
Original SEMI in stock.**

SHIP UP TO  
**5 lbs**  
FOR ONLY

**\$3.95**

2nd Day Air

Plus handling & C.O.D. charge if it applies



**Dalbani®**

4225 NW 72ND AVE. MIAMI, FLORIDA 33166  
TEL : (305) 716-1016 ----- FAX : (305) 594-6588

TO ORDER A CATALOG CALL "258"

**1-800-325-2264**

CIRCLE 313 ON FREE INFORMATION CARD

Tel: (954) 974-6864  
Fax: (954) 974-6818

# GATEWAY PRODUCTS CORP.

Please mail orders to:  
P. O. Box: 93-6397  
Margate, FL 33093

**Deal U3**.....\$5.00  
  
LM324  
LM339  
LM358  
NE555  
LM556  
LM741  
Linear ICs  
(12pcs total.... 2 pcs ea)

**Deal N1**.....\$3.00  
  
PN2222A  
2N3904  
2N4401  
NPN Transistors  
(30pcs total... 10pcs ea)

**Deal P9**.....\$3.00  
  
1N4148 .....switching  
1N4001 .....1A/50V  
1N4004 .....1A/400V  
1N4007 .....1A/1kV  
Diodes  
(40pcs total... 10pcs ea)

**Deal A2**.....\$3.50  
  
1uF 10uF  
2.2uF 22uF  
3.3uF 33uF  
4.7uF 47uF  
All caps: 50V  
Radial Latics  
(40pcs total.... 5 pcs ea)

**Deal A7**.....\$4.00  
  
10uF 100uF  
22uF 220uF  
33uF 330uF  
47uF 470uF  
All caps: 25V  
Radial Latics  
(40pcs total.... 5 pcs ea)

**Deal R4**.....\$3.00  
  
10pF 47pF  
22pF 100pF  
27pF 150pF  
33pF 220pF  
All caps: 50V  
Ceramic Disc  
(40pcs total.... 5 pcs ea)

**Deal T6**.....\$3.50  
  
1uF/35V  
2.2uF/35V  
10uF/16V  
Tantalum Caps  
(15pcs total.... 5 pcs ea)

**Deal V8**.....\$5.00  
  
CD4001B  
CD4011B  
CD4013B  
CD4017B  
CD4028B  
CD4050B  
CD4066B  
CMOS ICs  
CD4069B  
(16pcs total.... 2 pcs ea)

**Deal N9**.....\$3.00  
  
PN2222A  
2N3908  
2N4403  
PNP Transistors  
(30pcs total... 10pcs ea)

**Deal H8**.....\$4.00  
  
1N5401 .....3A/100V  
1N5404 .....3A/400V  
1N5408 .....3A/1kV  
6A10 .....6A/100V  
6A100 .....6A/1kV  
Power Diodes  
(25pcs total... 5 pcs ea)

**Deal G5**.....\$3.00  
  
1N34A, 1N60, 1N270  
Germanium Diodes  
(18pcs total.... 6 pcs ea)

**Deal X8**.....\$3.00  
  
1Amp 4Amp  
DF04M .....DIP  
W04M .....Round  
KBL04 .....In-line  
400V Bridges  
(6 pcs total.... 2 pcs ea)

**Deal R7**.....\$3.00  
  
270pF 01uF  
330pF 022uF  
470pF 047uF  
.001uF .1uF  
All caps: 50V  
Ceramic Disc  
(40pcs total.... 5 pcs ea)

**Closeout Items**  
(10 pcs min. No mix)  
2N2222A....25¢  
74LS174....20¢  
74LS244....20¢  
74LS245....20¢  
74LS374....20¢  
LF353N....25¢  
LM386N....25¢  
MC1488....25¢  
MC1489....25¢

**Deal M4**.....\$5.00  
  
7805 7812  
7808 7815  
12 pcs total  
(3pcs of each)  
(30pcs total... 5 pcs ea)

**Deal J1**.....\$3.50  
  
78L05  
78L12  
10 pcs total  
(5pcs of each)  
(9 pcs total.... 3 pcs ea)

**Deal Y6**.....\$2.00  
  
1N5817 .....1A/20V  
1N5818 .....1A/30V  
1N5819 .....1A/40V  
1Amp Schottky Diodes  
(9 pcs total.... 3 pcs ea)

**Deal Z7**.....\$3.00  
  
1N4728A .....3.3V  
1N4733A .....5.1V  
1N4739A .....9.1V  
1N4742A .....12V  
1N4744A .....15V  
1Watt Zener Diodes  
(25pcs total.... 5 pcs ea)

**Deal C5**.....\$4.00  
  
TIP 31C  
TIP 32C  
TIP 120  
TIP 125  
Transistors  
(8 pcs total.... 2 pcs ea)

**Deal B5**.....\$3.50  
  
.01uF 047uF  
.022uF .1uF  
50V Monolithic Caps  
(40pcs total... 10pcs ea)

Crystals .....45¢  
4.0000MHz 11.0000MHz  
11.0592MHz  
1/4" pushbutton  
Normally Open only .....20¢  
LM317T....45¢  
7818.....20¢  
79L05.....20¢

**Deal L3**.....\$3.00  
5mm (T1 3/4)  
Diff'd LEDs  
Red, Green  
and Yellow  
30 pcs total  
(5pcs of each)

**Deal L6**.....\$3.00  
3mm (T1)  
Diff'd LEDs  
Red, Green  
and Yellow  
30 pcs total  
(5pcs of each)  
(9 pcs total.... 3 pcs ea)

**Deal Y9**.....\$3.00  
  
1N5820 .....3A/20V  
1N5821 .....3A/30V  
1N5822 .....3A/40V  
3Amp Schottky Diodes  
(9 pcs total.... 3 pcs ea)

**Deal W2**.....\$3.00  
  
120pcs total... 20 pcs of  
each 10, 47, 100, 470,  
1k, 4.7K. All 1/4W 5%.

**Deal W5**.....\$3.00  
  
100pcs total... 20 pcs of  
each: 10K, 47K, 100K,  
470K, 1M. All 1/4W 5%.

**Deal S3**.....\$5.00  
Miniature size  
1/4" Panel hole  
spdt.....on-on  
spdt.....on-off-on  
dpdt.....on-on  
dpdt.....on-off-on  
(8 pcs total.... 2 pcs ea)

**SOLDER ROLL**  
SN83/37  
.031" dia  
1 Lb Roll  
**\$7.95**

**\$20.00 minimum order. We accept VISA, MC, MO, Check, No-CODs. Please add \$5.00 for shipping & handling (foreign addresses: \$8.50).  
Florida addresses add your applicable county sales tax. Hours: Mon-Fri: 9AM to 5PM (EST). All new premium parts. Send for free Catalog.**

CIRCLE 328 ON FREE INFORMATION CARD

## Radiotelephone - Radiotelegraph **FCC** Commercial License

### Why Take Chances?

Discover how easy it is to pass the exams. Study with the most current materials available. Our Homestudy Guides, Audio, Video or PC "Q&A" disks make it so fast, easy and inexpensive. No college or experience needed. The new commercial FCC exams have been revised, covering updated Aviation, Marine, Radar, Microwave, New Rules & Regs, Digital Circuity & more. We feature the Popular "Complete Electronic Career Guide". 1000's of satisfied customers Guarantee to pass or money back. Newest Q&A pools.

Send for FREE DETAILS or call

**1-800-800-7555**

**WPT Publications**  
4701 N.E. 47th St.  
Vancouver, WA 98661

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ St. \_\_\_\_\_ Zip \_\_\_\_\_

**1-800-800-7555**

## WHITE-STAR ELECTRONICS

TEL: 405-631-5153 FAX: 405-631-4788

CONVERTERS:	20	50	100+
Regal CR-83	.45	39	35
* New, Panasonic TZPC 145	.75	69	65
DQN-5 (2 or 3) (unmodified)	.45	39	35
DRZ-3 PJ (unmodified) 70 Channel Plain	.35	32	29
DRX-3 PJ (unmodified) 60 Channel Plain	.32	30	27

Call for FREE catalog.  
**405-631-5153**



REMOTE CONTROL HAND UNITS:	20	50	100+
Jerrold Replaces: 400/450/550	4.95	4.50	4.25
Scientific Atlanta: 075/175/475	4.95	4.50	4.25
8600: On screen display	7.50	7.00	6.50
Pioneer: BR 81, 82	4.95	4.50	4.25
Panasonic: Call for model #	7.50	7.00	6.50
Zenith: All	4.95	4.50	4.25
Tocom: 5503-VIP, 5503-A	7.00	6.50	6.25
Universal: 4 in 1 R/M	7.50	7.00	6.50

Call for Oak, Hamlin, Regal-83, Regency, Texscan, and all others.

Tamper-Bit tools: (10-lot)

Jerrold compatible bits:	
1/4" Stacom Bit	\$8.00
Oval Round D	\$20.00
Torx Bit:	
Tocom T-8	\$8.00
Zenith T-10,T-15	\$8.00
Pioneer T-20	\$8.00
Scientific Atlanta T-20	\$8.00
Pio 63XX Oval	\$20.00
Bit Driver Handle	\$4.00

We carry most remote hand units. If you don't find the one you're looking for, we can locate for you.

**Specializing in large quantities.**

HOURS: Monday thru Friday 9 am to 5 pm Central Time.

Call for FREE catalog.  
Email: wse405@aol.com

CIRCLE 314 ON FREE INFORMATION CARD

# PARTS EXPRESS

ELECTRONICS & MORE

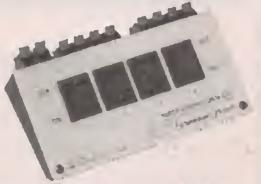
FREE  
244 PAGE  
CATALOG



UNBELIEVABLE  
VALUE!

## 4 Way Speaker Switch

Control up to 4 pairs of speakers with this compact speaker selector switch. Features circuit protector, heavy duty rocker switches, spring loaded terminals, and silver plated switch connectors. Includes one pair of amplifier inputs. Load to amplifier is minimum 4 ohms (with 8 ohm speakers) or 220 ohms with all speakers switched off. Net weight: 1 lb.



WAS \$22<sup>50</sup> EACH NOW \$15<sup>00</sup> EACH

#EN-309-030

## "The Sound Bridge" FM Stereo Wireless Transmitter

The Sound Bridge is a mini FM wireless transmitter that can be used to broadcast stereo sound from any audio source like portable CD players, TVs, electronic games, CD-ROM, even computer soundcards, to your home stereo receiver! Adjustable from 89 to 95.5 MHz.



#EN-249-220

\$14<sup>95</sup> EACH

HOT  
NEW  
ITEM!

## Weller Professional Irons



Perfect for a variety of electronic soldering work, this top quality iron features a long life, double coated tip and a quick change, plug-in heater element. Lightweight handle includes a comfortable cushioned grip. Net weight: 1/2 lb.

#EN-372-110 (25 Watt) ..... \$30<sup>90</sup> (1-3) \$28<sup>50</sup> (4-UP)

#EN-372-112 (35 Watt) ..... \$38<sup>90</sup> (1-3) \$34<sup>95</sup> (4-UP)

# Weller

Peak Instrument Co.

## "The Woofer Tester"

Peak Instrument Co. proudly introduces "The Woofer Tester". Just ask any loudspeaker engineer, and they will tell that the only way to design enclosures of the correct size and tuning is to measure the Thiele-Small parameters for the actual drivers to be used. The reason? Manufacturers published specs can be off by as much as 50%! But until now, measuring the parameters yourself required expensive test equipment and tedious calculations, or super expensive measurement systems (\$1,200 to \$20,000). The Woofer Tester changes all that.

Finally, a cost effective, yet extremely accurate way to derive Thiele-Small parameters, in only minutes! The Woofer Tester is a combination hardware and software system that will run on any IBM compatible computer that has EGA or better graphics capability and an RS232 serial port. The Woofer Tester will generate the following parameters. Raw driver data: Fs, Qms, Qes, Qts, Vas, BL, Re, Le, SPL @ 1W/1m, Mmd, Cm, and Rm. Sealed box data: Fsb and system Q. Vented box data: Fsb, ha, alpha, and loss. The Woofer Tester system includes hardware, test leads, serial cable, AC wall adapter, detailed instructions, and software.

#EN-390-800 ..... \$249<sup>00</sup> EACH



QUICKLY AND  
ACCURATELY  
MEASURES:  
Fs, Qms, Qes, Qts,  
Vas, BL, Re, Le,  
SPL @ 1W/m,  
Mmd, Cm, and Rm  
IN MINUTES!

30 DAY  
MONEY BACK  
GUARANTEE

1 YEAR WARRANTY

SAME DAY SHIPPING

## Home Theatre In-Floor Subwoofer

To fully appreciate the potential of movie soundtracks, a dual voice coil subwoofer is a must! Many film special effects are extremely demanding in the low frequency range and require a subwoofer that can duplicate explosions, earthquakes, even the footsteps of Tyrannosaurus Rex! This subwoofer fits the bill by featuring a 10" dual voice coil woofer for true stereo operation and high pass filters for your main speakers. The most unique feature of this subwoofer is the fact that it is designed to be mounted in between the floor joists in new and existing home constructions. Simply mount the in-floor sub to the joists and mount a heat register grill above opening in subwoofer front enclosure. The subwoofer is now totally out of view and ready to rumble! Includes detailed installation manual.

**Specifications:** 10" dual voice coil treated paper cone woofer with poly foam surround. Frequency response: 30-100 Hz. Nominal impedance: 8 ohms per coil. Power handling: 100 watts RMS channel/140 watts max. SPL: 89 dB 1W/1m. Dimensions: 27" D x 14-5/8" W x 9" H. Net weight: 29 lbs.

#EN-300-445 ..... \$139<sup>95</sup> EACH



## 900 MHz Wireless Speaker System

- ◆ 900 MHz technology sends signal up to 180 ft., through walls, floors and ceilings.
- ◆ Ideal for use as rear surround speakers or for adding wireless sound to every room in the house!
- ◆ Full range, bass reflex design with built-in high power, low distortion amplifier.
- ◆ Weather resistant cabinet for outdoor use.
- ◆ Selectable battery (six C size for each speaker) or AC operation, adaptor included. Built-in recharging circuitry for ni-cad batteries.
- ◆ System includes: 900 MHz transmitter, wireless speaker pair, AC adaptors, and all cables necessary to hook up system.
- ◆ Limited availability. ◆ Net weight 9 lbs.
- ◆ Frequency response: 20-18KHz.



\$169<sup>95</sup> EACH

Dayton Loudspeaker Co.®



1-800-338-0531

340 E. First St., Dayton, OH 45402-1257  
Phone: 937-222-0173 ◆ Fax: 937-222-4644  
E-Mail: sales@parts-express.com

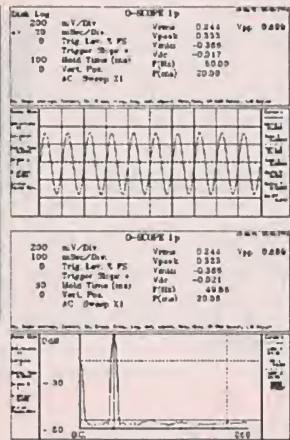
CIRCLE 262 ON FREE INFORMATION CARD

# DIGITAL STORAGE OSCILLOSCOPES

WITH  
SPECTRUM  
ANALYZER,  
DVM, FREQ.  
COUNTER,  
AND DATA  
LOGGER.

from  
**\$189.**

PORTABLE  
MODULES  
CONVERT PC'S  
INTO  
MULTIPURPOSE  
TEST AND  
MEASURING  
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

## FEATURES:

- PORTABLE UNITS TO 25 MHz
- USES PRINTER PORT
- USES STD. PROBES

O-Scopes Made in U.S.A.

Same Day Shipping

Includes Cable, Software & Manuals

O-Scope I (DC-50KHz, single trace) .....	\$189.
O-Scope II (DC-500KHz, dual trace) .....	\$349.
PICO (ADC 200/20) (DC-10MHz, dual trace) .....	CALL
PICO (ADC 200/50) (DC-25MHz, dual trace) .....	CALL
PICO pc based data loggers from \$99.	

Shipping within U.S. UPS Ground \$7.50 (Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

**1-800-980-9806**

**Allison Technology Corporation**

8343 CARVEL, HOUSTON, TX. 77036 U.S.A.

PHONE: 713-777-0401 FAX: 713-777-4746 BBS: 713-777-4753

<http://www.atcweb.com>

# EPROM Emulator

## Sockit Rockit



**\$99.00\***

Emulates:  
27C256  
27C128  
27C64

The SR256 EPROM Emulator can emulate 8K x 8 to 32K x 8 120 ns EPROMs, with features that provide embedded code developers increased productivity. Advantages include: software selectable device size and target address; download verify; Hex, S-Record and binary file support; status LED; dual polarity reset outputs and single device bus loading.

## INCLUDES

- PC Software and Quick Start Manual
- Table Assembler supporting common 8-bit micros
- PC Parallel Port Adapter and 7 ft. Interface Cable
- Reset Jumper Wire

*\*Shipping and handling not included.  
VISA, MasterCard, Discover and AmEx accepted.*

## Wisch Communications

2550 Trinity Mills Road  
Suite 132B  
Carrollton, TX 75006

Ph: (972) 417-3533  
Fax: (972) 417-3821  
wischcom@cyberramp.net

## THE HACKER'S COMPANION CD-ROM

Are you interested in using the internet in ways you never dreamed possible? Want a war-dialer program or something to crack a password? Do you want to learn how the phone company gets ripped off, or learn how-to build a red box, or modify a cellular phone? Want to see what the security holes in Windows NT are? Or how to compromise a Unix machine or a BBS? Want to learn how to use the system in ways you never imagined possible? This CD is the place to look! It contains all kinds of computer, telephone and general hacking information. Even a video of dutch hackers breaking into a classified US military computer! In all, over 600 megabytes of fascinating information that's hard to get anywhere else!

**PC-COMPATIBLE CD \$29.95 SHIPPING \$3**

## Cryptography Unlimited CD-ROM

Cryptographic software will soon be outlawed by the US government. Get this important bundle of over 200 megabytes of cryptographic software while you still can! Nobody in the US will even dare to publish a CD like this anymore and we had to import it from Africa! Includes file encryptors, disk encryptors, PGP, steganography, code cracking, PGP phone and lots more!

**PC CD-ROM \$39.95 SHIPPING \$3**

**Call (800)719-4957 now!**

to order (Visa/MC/COD) or call or write for **FREE CATALOG** of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

**American Eagle Publications, Inc.**  
P. O Box 1507, Dept E  
Show Low, AZ 85901

CIRCLE 315 ON FREE INFORMATION CARD

# MCM ELECTRONICS®

The Source For  
All Of Your  
Electronics Needs

Prices Effective February 5  
through March 31, 1998

To take advantage of special  
pricing on the items listed, you  
must provide this code: ▼

SOURCE CODE: ENS44



**Valor**  
The Core Connection  
Six Position

### Antenna Coax Switch

Heavy duty six position switch is ideal for all HF and VHF antenna switching applications including Citizens Band. Frequency range 0-250MHz. 1500W P.E.P maximum. Tested insertion loss: <.15dB on the 220MHz band, <.05dB on the 2M band, <.021 dB on the 6M band, <.020 dB on the 10-160M band including CB. All connectors are SO-239 type. Suggested list \$39.95. Limited quantities.

Order #	(1-4)	(5-up)
58-2820	\$22.50	\$19.95



### Multi Voltage

**Regulated Power Supply**  
Ideal for any device drawing up to 2A. Fully regulated to deliver constant DC voltage. Rotary selector switch selects 3, 4 1/2, 6, 7 1/2, 9 and 12V. Power projects or small battery operated devices. Color coded binding posts make connection easy.

Order #	(ea.)
28-2200	\$16.95



### AC Traveler Inverter

Provides on-the-road AC power from your cigarette lighter. Lightweight, portable power inverter supplies 117VAC, 60Hz, modified sine wave output from 13.8VDC input. Operates devices up to 140W continuous, 200W surge output. Ideal for small electronic devices, work lamps and many other items.

Order #	Reg.	
72-3090	\$79.95	\$59.95



### MCM AUDIO SELECT™

#### Poly Cone Woofers

Just a sample of nearly 200 different types of woofers stocked at

MCM. These foam surround, polypropylene cone woofers are excellent for automotive use or repair/upgrade of home speaker systems. Listed models are 8ohm. 4ohm also available. Call for quantity discounts.

Order #	Size	RMS/Peak	Response	Magnet	(ea.)
55-1170	6 1/2"	45W/60W	40Hz-5KHz	18 oz.	\$9.49
55-1195	8"	70W/100W	40Hz-3.5KHz	18 oz.	11.95
55-1250	10"	70W/100W	28Hz-5KHz	20 oz.	18.95
55-1255	12"	75W/100W	25Hz-4KHz	30 oz.	22.95



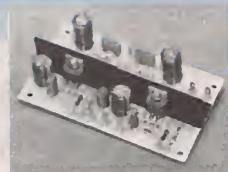
### Five Watt Single Channel Audio Amplifier

Pre-assembled audio amplifier board can be used for many applications

including repair or modification of equipment, projects or prototype work. Accepts line level input, 100mV, 100Kohm. Output impedance 4-8ohm. Operates with supply voltage from 6-16VDC, 250mA. Optimum 12VDC. Includes oversized heat sink. Board dimensions 50mm x 40mm x 20mm.

Order #	(ea.)
28-4796	\$13.95

Call for information on many other types of pre-assembled modules including timers, counters, temperature controls, VOX relays, Programmable LCD displays and power supplies.



### 5 Watt x Two Channel Audio Amplifier

Offers the same features as the #28-4796, with two channel output. Requires 500mA. Board dimensions 90mm x 55mm x 27mm.

Order #	(ea.)
28-4800	\$24.95



### TENMA® DMM with Logic Function

Features 3/4 digit LCD display, 10Mohm input impedance, 2.5 per second measuring rate, logic, diode and transistor hFE test and overload protection. Measures AC/DC voltage to 600V, resistance to 2000Mohm, AC/DC current to 10A, and capacitance to 20mF. Dimensions: 2 1/4" (W) 5 1/4" (H) 1 1/4" (D). Protective holster included.

Order #	Reg.	
72-4025	\$65.95	\$39.95



### 30 Piece Security Tool Set

This is a complete set of security bits for all of those difficult service applications, such as IBM PS/2 monitors, cable boxes, telephone equipment and many others. Kit contains security hex bits, security torx bits, spanner bits, tri-wings and more. Takes the frustration out of those difficult service situations.

Order #	Reg.	
22-1475	\$39.99	\$19.95

**MCM ELECTRONICS®**  
650 CONGRESS PARK DR.  
CENTERVILLE, OH 45459  
A PREMIER FARRELL Company



### Same Day Shipping!

In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.

**1-800-543-4330**

[www.mcmelectronics.com](http://www.mcmelectronics.com)

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

SOURCE CODE: ENS44

# EARN MORE MONEY!

## Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

**No Need to Quit Your Job or Go To School**  
This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

### COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210  
P.O. Box 2824, San Francisco, CA 94126  
Please rush FREE details immediately!

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

## ONLY COOL-AMP SILVERPLATES ON THE JOB.

From a customer testimonial:

"Ok, your edge connectors don't connect. Or you want to plate your own PC creations, but you don't want to bother with electro-plate solutions. The plating on the socket...has worn off and no longer makes reliable contact...what are you going to do now?"

"Give the people at Cool-Amp a call. They have a silver plating compound I have used for the past couple of years that solves all of the above problems and more. This white powder has an infinite shelf life...and is easy to use."

"It will actually put a permanent silver plate on copper, brass or bronze...There are no messy or dangerous chemicals. Application could not be easier. Use a clean rag and a little bit of water and just rub it on a clean surface. In minutes you can permanently silver plate a circuit board or replate a power amp tube or socket."

"It has saved me time, money and my sanity."

Cool amp has even outperformed electroplating in recent tests. It is time-proven since 1944.

**COOL-AMP**

## AND CONDUCTO-LUBE. THE SILVER-BASED CONDUCTIVE LUBRICANT.

The upstart, since 1952. Developed for switches, uses continue to expand to all applications needing a conductive lubricant.

**Conducto-Lube**

**ORDER FACTORY DIRECT:**  
**503-624-6426 or FAX 503-624-6436**

<http://www.thomaregister.com/cool-amp>



# Wireless Video Headquarters

## The Cube



### World's Smallest TV Transmitter

Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W up to 150' to any TV tuned to cable channel 59 with a solid 20 mW of power. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Deluxe model includes sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Our cameras shown below have been tested to mate perfectly with The Cube and work great. Fully assembled.

**C-2000 Video Transmitter Cube** ..... \$89.95

**C-3000 Video and Audio Transmitter Cube** ..... \$149.95



### CCD Video Cameras

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. These cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, these are super IR (Infra-Red) sensitive! Available with Wide-angle (80°) or super slim Pin-hole style lens. Both run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our Interface board (below) for Audio sound pick-up and direct wire connection to any Video monitor or TV video/audio input jacks. Fully assembled.

**CCDWA-2 CCD Camera, wide-angle lens** ..... \$99.95

**CCDPH-2 CCD Camera, slim fit pin-hole lens** ..... \$99.95

### CCD Camera Interface Board

Here's a nifty little kit that eases hook-up of your CCD camera module to any video monitor, VCR or video input TV set. The board provides a voltage regulated and filtered source to power the camera (CCD Cameras require a stable source of power for best operation), sensitive electret condenser mike for great sound pick-up and RCA Phono jacks for both audio and video outputs. Runs on 11 - 20 VDC.

**IB-1 Interface Board Kit** ..... \$14.95



### Budget TV Transmitter

Transmit audio and video to any TV set with this fully assembled transmitter. Although not tiny, it still offers some neat features. Takes standard 1 volt p-p video and audio and transmits on any UHF TV channel of your choice from 17 - 42. Has rugged metal case, includes AC adapter, whip antenna and even RCA phono plug patch cords! Can also run on 12 VDC.

**VS-2 Video and Audio Sender, Fully Assembled** ..... \$29.95

### IR Illuminator for CCD Cameras

See in total darkness with one of our CCD video cameras and this IR illuminator! IR light can't be seen, illuminate the scene with IR and a CCD camera 'sees' just fine. The array of 24 extra high intensity LEDs are invisible to anybody - except for aliens and Casper! Runs on 12 VDC. Illuminates similar to that of a bright flashlight.

**IR-1 IR Illuminator Kit** ..... \$24.95



### MicroEye CCD Camera & Transmitter Combo

We married together one of our quality CCD cameras, a sensitive electret microphone and a small TV transmitter to give you a super neat - and tiny - all in one, 'knows all, sees all, hears all' package! Small enough to fit into a cigarette pack and powerful enough to transmit up to

150' to any standard TV set. Tunable to operate on TV channels 4, 5, or 6 and runs on 9 to 20 VDC. The sensitive mike picks up normal voice within an average size room. Ideal for private detectives, investigators, hobbyists, babysitters, model rocketeers, RC airplanes and other uses limited only by your imagination. Camera module is fully wired and the transmitter unit is an easy to build kit that goes together in an evening. Includes all parts, handsome jet-black case and clear, concise instructions with ideas for use. And, don't forget, our CCD cameras are very sensitive to IR light - just add the IR-1 IR Illuminator kit for see-in-the-dark operation!

**ME-2000 MicroEye TV Transmitter Combo** ..... \$149.95



### Wavecom Wireless Video and Audio Transmission System

Transmit extremely clean and sharp video and audio up to 300 feet. Wavecom transmits in the 2.4 GHz band using FM and circular polarization for state-of-the-art transmission.

There is no fading, ghosting, humming, buzzing or picture rolling when using the Wavecom. System consists of two parts, a transmitter unit and a receiver unit. Switch selectable 4 channel operation allows use of multiple Wavecoms in the same geographic area. Connections are video and audio in and out using standard RCA phono jacks. Includes AC wall plug adapters, patch cords, coax cable jumper, TV antenna A/B switch and complete hook-up instructions. Fully assembled with one year warranty.

The Wavecom Sr. has all of the features above plus adds the capability of transmitting your TV/DSS/VCR remote control signals from the receiver unit back to the transmitter unit. This is great for controlling your DSS satellite receiver or VCR from any room in the house. We also offer the small internal transmitter module assembly for those who wish to make their own concealed video transmitter system. Module is about the size of a couple of matchboxes and includes microwave patch antenna.

**WC-1 Wavecom Jr. Wireless System** ..... \$189.95

**WC-5 Wavecom Sr. with Remote Capability** ..... \$239.95

**WC-TX Transmitter Module Assembly** ..... \$105.00

### RAMSEY ELECTRONICS, INC.



793 Canning Parkway Victor, NY 14564

Call for our free catalogue or visit us on the web: [www.ramseyelectronics.com](http://www.ramseyelectronics.com)

### Toll-free Order Service: 1-800-446-2295

Sorry, no technical info or order status at this number

### For Tech Info or Order Status, Call the Factory Direct

Phone (716) 924-4560

Fax (716) 924-4555

**ORDERING INFO:** Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$5.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.



## AUTOMATIC TELLER MACHINES

ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, includes: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, tapping, spoofing, inside job, vibration, pulse, high voltage - others, con jobs. Histories, law, security checklist, internal photos, figures. Much more! \$39.

## CELLPHONE PHREAKING GUIDE

How cellphones operate and are modified. Vulnerabilities to hack attack and countermeasures. Details on programming NAMs, ESNs, etc (cloning), control data formats, computing encoded MINs, ESNs, SIDHs, operating systems, PROM programming, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming. Step-by-steps to keypad-reprogram 100+ popular cellphones. More! \$59

## PAGER / BEEPER MANUAL

How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How Pagers are hacked/countermeasures. And plans for a **Personal Pocket Paging System** (xmitter and receiver). More! \$29

**TOP SECRET**

MAIL \$3 FOR OUR LATEST CATALOG TO: (free w/ order)

## CONSUMERTRONICS

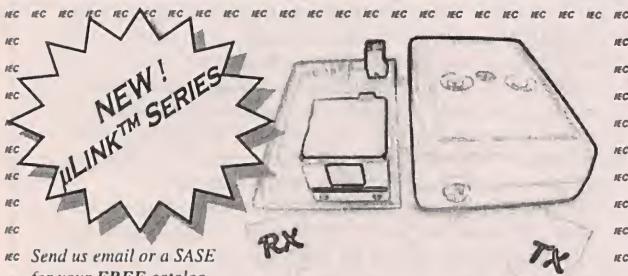
P.O. Box 23097 ABQ, NM 87192-1097

ORDER TODAY! 505-237-2073

Fax: 505-292-4078 Web Adventure: [www.tsc-global.com](http://www.tsc-global.com)

Established in 1971. Featured on CBS "60 Minutes," Forbes, New York Times. Add \$5 total S/H (US, Canada). Sold for educational purposes only. Postal M.O. is fastest. VISA, MC OK. COD (\$49-\$999), add \$7.

CIRCLE 226 ON FREE INFORMATION CARD



Send us email or a SASE for your FREE catalog

### μLink™ Infrared Remote Control System

- 4 Function IR Transmitter (pcb 1.1"x 1.9") #IRTX4-A
- 4 Function IR Receiver (pcb 1.1"x 1.9") #IRRX4-A
- Receiver can LEARN up to 4 transmitters.
- Each transmitter can have a different access level.
- User selectable receiver output modes.
- Up to 9m Range. Great for security and hobby applications.
- RX and TX IC's available.

Only \$39.95/pair + S&H, additional IRTX4-A units \$19.95

### SURFACE MOUNT KITS:

- Pager Decoder Interface
- Garage Door Opener
- Wireless FM mic and more

### SERVICES:

- Circuit Board Manufacturing
- PIC Programming
- Member IPC

Orders: 1-800-417-6689 Mon-Fri 9AM-6PM ET

visa/mastercard/money orders

email: [iecorp@i-e-c.com](mailto:iecorp@i-e-c.com)

web: <http://home.earthlink.net/~iecorp>

IEC ♦ PO Box 52347 ♦ Knoxville TN 37950

COPYRIGHT ©1997 International Electronics Corp.

## PHREAKING CALLER ID & ANI

How they work and dozens of ways of defeating Caller ID, ANI, '69, '57, Call Blocking, '67 etc. Describes ESS, SS7, CNA, CAMA, DNR, Diverters, Centrex - more! \$19.

## BEYOND VAN ECK PHREAKING

Eavesdropping on TV and computer video signals using an ordinary TV described in detail. Includes security industry reports. Range up to 1 KM. Plans include both the ours and the original Top Secret Van Eck designs! \$29.

## HACKING THE INTERNET

The latest tricks and methods being used on the Net to pirate software (warez) and the newest hacking websites. Updated every two months. Includes examples, countermeasures, password defeats, UNIX, Sprintnet, brute force methods, lots of tips, and more! \$25.

## COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk! \$39.

## OTHER EXCITING TITLES

Call For Descriptions

Hacking Fax Machines - \$29

PBX Hacking - \$19

Voice Mail Hacking - \$29

Beyond Phone Color Boxes - \$29

Hacking Answering Machines - \$19

By an Order of the Magnitude - \$49

Ultimate Success Manual - \$15

Internet Cons & Scams - \$19

Internet Tracking & Tracing - \$29

Cookie Terminator - \$19

Casino Hacking - \$18

Credit Card Scams - \$29

Radionics Manual - \$29

Heal Thyself - \$19

Stealth Technology - \$24

High Voltage Devices - \$29

The Hacker Files - \$39

Cons & Scams - \$29

Cryptanalysis Techniques - \$29

Secret & Survival Radio - \$24

Secret & Alternate IDs - \$15

Rocket's Red Glare - \$29

Mind Control - \$29

EM Brainblaster - \$29

## SPECIAL PROJECTS SERVICES

We will build just about anything.

Ask about our application form!

## STOPPING POWER METERS

## STOPPING POWER METERS

As reported on "60 MINUTES"!

All-new 6th Edition!! Over 45 pages jam-packed with how-devices can slow down (even stop) watt-hour meters - while loads draw full power! Device plugs into one outlet and normal loads into other outlets. Describes meter creep, overload drop, etc. Plans only! \$29.

**THE I.G. MANUAL:** External magnetic ways (applied to meter) to slow down and stop power meters while drawing full loads. Plans \$25.

**KW-HR METERS:** How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and PolYPHASE Meters. Experimental results to slow and stop meters by others. \$25.

All 3 (above), Only \$59! (Add \$20 for Video)

## NEW S.P.M. THE VIDEO!! \$39



Now its easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM related manuals!

Only \$49 for SPM video + SPM manual!!

## RF Data Modules

### Transmitters



TXM-4XX-A..... \$24.50  
TXM-4XX-F..... \$25.80

- ERP 0.25mW into 50Ω
- 3V(F), 5V(F) or 6-12V(A)
- 418 or 433.9Mhz FM
- simply add antenna, data, power
- Range up to 200m
- Analog or digital data i/p
- SAW controlled - stability

### Receivers



SILRX-4XX-A..... \$39.38  
SILRX-4XX-F..... \$41.92

- Only 21 x 47 x 5mm
- 13mA; 130uA on power save (100:1)
- Carrier detect o/p
- 418 or 433.9MHz FM Superhet
- SAW controlled - stability
- Analog or digital o/p
- Wide supply range 4.5-9V (A/F ver.)
- Fast enable time <3ms

### Transceivers



BIM-4XX-F..... \$87.36

- Only 23 x 33 x 11mm
- Up to 40,000bps of balanced code
- Up to 170m range.
- 5v operation
- 418 or 433MHz FM
- Direct interface to 5V CMOS logic
- Fast 1ms enable from power saving

### RS232 Transceiver



CYPHERNET -RS232..... \$139.30

- 3 wire RS232 interface
- Up to 38400 bps
- 418 or 433MHz FM, 7.5-15Vdc
- TX/RX LED indication
- Up to 150m range



Volume Discounts  
Free Catalog Available

Tel: 416-242-3120  
Fax: 416-242-2697  
FaxBack: 416-242-3082

MasterCard / Visa

67 Hamptonbrook Dr • Weston • ON • M9P 1A2 • Canada

# AGS

## Introduces the "BasicBox"



The AGS **BasicBox**, is a single board microcontroller. Designed not only as a learning tool, it will also quickly adapt to real world control solutions. The **BasicBox** comes complete with software, power supply, cable for PC or Mac, and is bundled with Jan Axelsons "Microcontroller Idea Book". From the electronics novice to the experienced engineer, the **BasicBox** is the answer when it comes to microcontroller application and implementation.

Single Quantity : \$249.00

Call, Fax or E-mail us today or visit our site on the world wide web  
 Web <http://www.agc-gv.com> Phone 530-887-1619 Fax 530-268-0116

*AGS, paving the way to tomorrow's technologies*

CIRCLE 335 ON FREE INFORMATION CARD

**CONTROL**  
RELAYS • LIGHTS • MOTORS

**MEASURE**  
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY

**INPUT**  
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

<b>MODEL 30</b> ..... \$79	<b>MODEL 45</b> ..... \$189
<ul style="list-style-type: none"> <li>• PLUGS INTO PC BUS</li> <li>• 24 LINES DIGITAL I/O</li> <li>• 8 CHANNEL-8 BIT A/D IN</li> <li>• 12 BIT COUNTER</li> <li>• UP TO 14K SMP/SEC</li> </ul>	<ul style="list-style-type: none"> <li>• RS-232 INTERFACE</li> <li>• 8 DIGITAL I/O</li> <li>• 8 ANALOG INPUTS</li> <li>• 2 ANALOG OUTPUTS</li> <li>• 2 COUNTERS-24 BIT</li> </ul>
<b>MODEL 100</b> ..... \$279	<b>MODEL 150-02</b> .... \$179
<ul style="list-style-type: none"> <li>• 12 BIT 100 KHZ A/D</li> <li>• 4 ANALOG OUTPUTS</li> <li>• 3 TIMER COUNTERS</li> <li>• 24 DIGITAL I/O</li> </ul>	<ul style="list-style-type: none"> <li>• RS-232 INTERFACE</li> <li>• TRMS, 20 AMPS</li> <li>• 12 BIT A/D</li> <li>• OPTO-ISOLATED</li> <li>• COMPLETE DMM</li> </ul>
<b>MODEL 40</b> ..... \$99	<b>MODEL 70</b> ..... \$239
<ul style="list-style-type: none"> <li>• RS-232 INTERFACE</li> <li>• 28 LINES DIGITAL I/O</li> <li>• 8 ANALOG INPUTS</li> <li>• PWM OUTPUT</li> </ul>	<ul style="list-style-type: none"> <li>• RS-232 INTERFACE</li> <li>• 12 BIT A/D</li> <li>• 5.5 DIGIT</li> <li>• UP TO 60 SMP/SEC</li> </ul>

**Prairie Digital, Inc.**

PHONE 608-643-8599 • FAX 608-643-6754  
 846 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

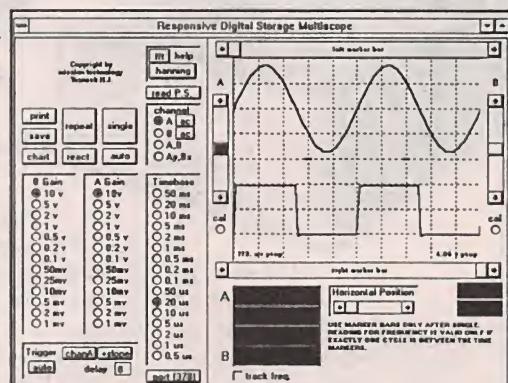
CIRCLE 325 ON FREE INFORMATION CARD

## TURN YOUR PC INTO A DIGITAL STORAGE OSCILLOSCOPE!

The all-new  
PC-MultiScope  
2

10Mhz  
analog  
bandwidth!

At right:  
Actual  
scope  
screen as  
seen on  
your PC  
monitor.



For industrial, educational, hobbyist, auto, and audio test & measurement

\$399 + S/H. Visa/MC/Check OK  
 Add \$99 for source code option

The top choice of corporations, universities and scientists worldwide!

AMAZE ELECTRONICS CORPORATION  
[amaze@hooked.net](mailto:amaze@hooked.net) [www.hooked.net/users/amaze](http://www.hooked.net/users/amaze)  
 Phone: 800-996-2008 Fax: 408-374-1737

# ❖ ATTENTION CABLE VIEWERS ❖

**CABLE VIEWERS...** get back to your **BASIC** Cable Needs



**BASIC**  
**ELECTRICAL**  
**SUPPLY &**  
**WAREHOUSING**  
**CORPORATION**

**Call 800-577-8775**

For information regarding all of your **BASIC** cable needs.

## 5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment ONLY - Don't trust last year's OBSOLETE and UNSOLD stock!  
**COMPETITIVE PRICING—DEALERS WELCOME**

**HOURS: Monday-Saturday 9-5 C.S.T.**

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.

\*Refer to sales personnel for specifications

**P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775**

CIRCLE 282 ON FREE INFORMATION CARD



## Digital Power Meter

Measures  
Watts  
& Watt-hours  
(kW-hr)

Simple to use.

Plug the Power Meter into any  
115V AC outlet, and plug the appliance to be  
measured into the Power Meter. That's it!

- Measure REAL ("true") power 3 to 1850 Watts
- Measure Power used, 1 Watt-hour to 9999 kilo-Watt-hr
- Measure power cost (\$), just enter cost per kilo-Watt-hr
- Microprocessor based circuitry
- 16 character LCD display • 4 button keypad
- Digital processing handles any AC waveform, any power factor
- Lifetime Warranty!

Self Calibrating for excellent accuracy!

Performs the same functions as instruments costing \$500-\$1000!  
No other instrument on the market even comes close for this price!!

**Only \$149.95 Delivered! MC/Visa/MO/Check**

To order, call toll free

**1-888-433-6600**

Brand Electronics,  
421 Hilton Rd.  
Whitefield, ME 04353  
For information only, call 1-207-549-3401

NEW

**PCBoards**

## PCB Artwork Made Easy!

### PRINTED CIRCUIT DESIGN SOFTWARE

For DOS & WINDOWS

Layout - Autorouting - Schematic - Circuit Simulation

- \* New - Ripup and Retry Router in Advanced Pkg.
- \* Copper Flooding for Building Ground Areas
- \* Gerber and Excellon Output
- \* Create Negative & Positive Printouts
- \* Create Single or Multi Layer Boards
- \* Create artwork from the Schematic
- \* Analog and Digital Simulation available
- \* Make boards up to 32" x 32"
- \* Parts Libraries - Silk Layers - Solder Mask
- \* Great for All Circuit Design Projects!

Download Demos from BBS (205)933-2954

**PCBoards Layout** for DOS **\$99**

**Windows™ Version** starts at **\$149**

Call or Write for Full Product Line, Prices & Demo Packages

**PCBoards**

2110 14th Ave. South  
Birmingham, AL 35205

(800)473-7227

Fax (205)933-2954  
Phone (205)933-1122

# Any waveform you want!



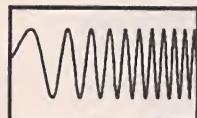
Starting at

**\$795**

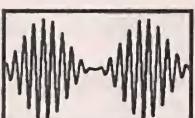
Quantity 1

Money back  
guarantee

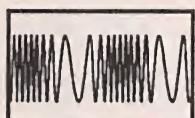
## Telulex Inc. model SG-100



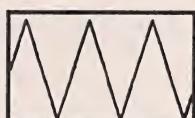
DC to 20 MHz linear  
and log sweeps



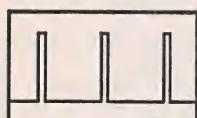
Int/Ext AM, SSB,  
Dualtone Gen.



Int/Ext FM, PM,  
BPSK, Burst



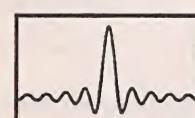
Ramps, Triangles,  
Exponentials



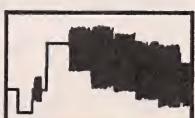
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

**Telulex Inc.**

2455 Old Middlefield Way S Tel (415) 938-0240 <http://www.Telulex.com>

Mountain View, CA 94043 Fax (415) 938-0241 Email: sales@Telulex.com

CIRCLE 324 ON FREE INFORMATION CARD

## PIC'n Books

### LEARN ABOUT PIC16/17 MICROCONTROLLERS

#### EASY PIC'n

Beginner

- Programming techniques
- Instruction set
- Addressing modes
- Bit manipulation
- Subroutines
- Sequencing
- Lookup tables
- Interrupts
- Using a text editor - source code
- Using an assembler
- Timing and counting
- Interfacing - I/O conversion
- Lots of examples

\$29.95

#### PIC'n Up The Pace

Intermediate

- Serial communication
- PIC16 to peripheral chips
- PIC16 to PIC16
- Serial EEPROMS
- LCD Interface
- Scanning keypads
- D/A conversion
- Sensors - analog voltage output
- A/D conversion
- Math routines
- Decimal interface
- PIC16C84 EEPROM data memory
- Lots of circuits and code

\$34.95

+ \$4 s/h in US for one book, \$6 both books

VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax

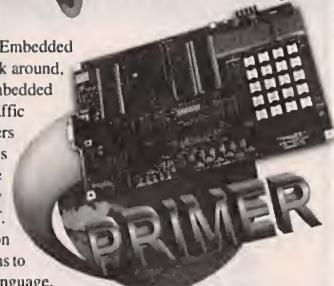
PIC is a trademark of Microchip Technology Inc.

**SQUARE 1** ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451  
Voice (707) 279-8881 FAX (707) 279-8883  
<http://www.sq-1.com>

## World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!



#### Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

**EMAC, inc.**  
11 EMAC WAY, CARBONDALE, IL 62901  
618-529-4525 Fax 457-0110 BBS 529-5708  
World Wide Web: <http://www.emacinc.com>

1985 - 1998  
OVER  
**12**  
YEARS  
OF SERVICE



- PRODUCT ENGINEERING
- FIRMWARE DEVELOPMENT

- MICRO CONTROLLER & EPROM HARDWARE & SOFTWARE DEVELOPMENT

**"QUALITY  
IS OUR  
CAPITAL  
CONCERN."**

**Complete On Site  
Electrical Engineering Lab**

- REVERSE ENGINEERING
- RF CIRCUIT DESIGN & MANUFACTURING

From Auto-Routing to CNC Routing to Electronic Assemblies...  
**Capital Electronics** is Your Best Route For Printed Circuit Boards.

**DESIGN/LAYOUT**

- CAD LAYOUT SERVICES
- COMPATIBLE WITH ALMOST ALL CAD SYSTEMS
- FROM SCHEMATICS OR SAMPLE PCB'S
- PHOTOPLOTTING SERVICES
- 28,800 BAUDE MODEM

**PRINTED CIRCUIT BOARDS**

- SINGLE & DOUBLE SIDED
- MULTI-LAYER & FLEXIBLE PCB'S
- FROM QUICK TURN PROTOTYPES TO SCHEDULED PRODUCTION RUNS
- FINE LINES, SMT
- ELECTRICAL TESTING
- PRECIOUS METAL PLATING

**ASSEMBLY SERVICES**

- FAST TURN BOARD STUFFING
- WIRE HARNESSES
- WAVE SOLDERING
- ACQUISITION OF PARTS
- FINAL TESTING
- TURNKEY SERVICES
- CUSTOM ENCLOSURES

*For Quick & Competitive Pricing or More Information,  
Please Call Us Today!*

303 Sherman Street • Ackley, Iowa 50601

**(515) 847-3888**

Fax (515) 847-3889 • Modem (515) 847-3890



*Internet Access:*  
For Automated Info Response:  
INFO@capital-elec.com  
E-Mail: Quote@capital-elec.com  
Web Access: http://www.capital-elec.com

CIRCLE 320 ON FREE INFORMATION CARD

**"7-WAY COPY CAT \$995.00\*"**

**NEW!  
7-Way  
StarTac  
\$1295.\***



Does.. 1. MOTOROLA (includes elite and EE3)! 2. NEC (includes P100-200-300-400-600-700)! 3. AUDIOVOX (does new 800 & 850)! 4. PANASONIC! 5. SONY (H333)! 6. MITSUBISHI-DIAMONDTE.L! 7. GE-ERICSSON (includes new version)!

We offer complete upgrade options on older units as well as new and replacement cables. We also offer used and refurbished units. For a compete catalog, visit us on the web at [www.celltec.com](http://www.celltec.com)

**Upgrade  
Your Old Copy  
Cat NOW  
to a 7-Way  
with EE3  
& StarTac**

\*cables optional

All units are sold for **EXPERIMENTAL AND EDUCATIONAL PURPOSES ONLY!**

**CALL US TODAY AT 770.973.8474**

CIRCLE 311 ON FREE INFORMATION CARD

# Does your Desoldering Tool really **SWICKY?**

**If not, try one of my two favorites.**

I have attended many trade shows worldwide in the last few years and these are the top two Desoldering Tools that I have found. You have probably seen the testimonials on the DEN-ON SC-7000Z in the last several issues. If you wish to see a copy or referrals from technicians in your state, call toll free and we will fax it to you immediately.



Price includes  
one extra filter  
and tip cleaner

**Sale Price  
\$395.00**

## New Features and Specifications

- Totally Self Contained diaphragm vacuum pump and AC motor (In the handle) for high vacuum suction or reversible hot air blow for SMD removal.
- 100Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.
- Maximum vacuum of 650mmHg is attained in 100 milliseconds.
- Temperature adjustable from 300°C - 500°C (572°F - 932°F).

- ◆ Voltage—AC100v,120V,230V,50/60HZ
- ◆ Power Consumption—120W
- ◆ Pump—Diaphragm Type
- ◆ Motor Output—2W
- ◆ Vacuum Attained—650mmHg
- ◆ Temperature Range—300°C—500°C (572°F—932°F)
- ◆ Air Flow Rate—15 Liter/Minute (Open)
- ◆ Heater—100W (Ceramic)
- ◆ Control System—Feed Back Zero Cross-over Type
- ◆ Net Weight—420Grams

*Check us out on the WEB*

<http://www.heinc.com>

**EDSYN**

## New Features

EDSYN has redesigned and improved their most popular ZD500 SOLDA-PULLT Hot Tip Self-Contained Desoldering Station and renamed it the ZD500DX .

- ⇒ New control circuitry for more precise temperature control, heat transfer, stability and calibration.
- ⇒ New vacuum pump design for improved performance and appearance.
- ⇒ New external calibration assists with ISO9000 compliance.
- ⇒ Updated modular design for easier maintenance.
- ⇒ Adjustable trigger and head assembly for comfort and ease of operation.
- ⇒ Wide range of tips available for all applications.
- ⇒ Vacuum Pump starts when handle is lifted from holder, thereby placing full vacuum at the trigger switch waiting for the trigger to be depressed. This allows for increased performance over conventional competitive models.

**\$649.00**

**Demo Units available to Qualifying Companies**

Visa - M/C - Discover - American Express - Terms to Qualifying Companies  
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty

**HOWARD  
HEI  
LECTRONIC  
INSTRUMENTS  
INC**  
6222 N. Oliver Kechi, KS 67067

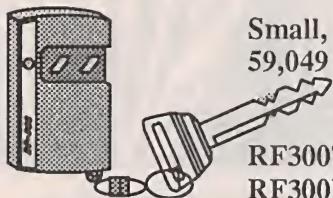
Toll Free U.S. and Canada

**1-800-394-1984**

CIRCLE 321 ON FREE INFORMATION CARD

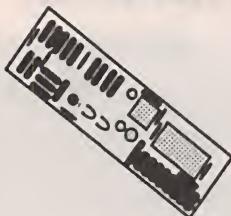
Web Site [www.heinc.com](http://www.heinc.com)  
E-Mail [sales@heinc.com](mailto:sales@heinc.com)  
International (316) 744-1993  
or Fax (316) 744-1994

# Miniature Transmitters and Receivers



Small, Attractive, High End Quality, 2 Channel 318 MHz Transmitter  
59,049 Settable Codes, 120'-300' Range, 1-1/4" x 2" x 9/16", Assembled

	Qty	1	5	10
RF300T 150' Range Transmitter		24.95	19.95	15.95
RF300XT 300' Range Transmitter		29.95	24.95	19.95



Small, High End Quality, 2 Channel Receiver for the RF300 Transmitters  
1-1/4" x 3-3/4" x 9/16" PCB w/ .1" spaced pads for standard connectors  
Input: 8-24 vdc Output: Gated CMOS Momentary and Latching Lines

	Qty	1	5	10
RF300R Receiver, Fully Assembled		24.95	20.95	16.95
RF300RK Receiver, Complete Parts Kit		19.95	15.95	12.95
RF300PA Pre-Amplifier. Doubles Range		14.95	11.95	9.95



Small, Economical, Single Channel Transmitter and Receiver Set  
Set Code, 60' Range, 1-7/8" x 2-3/8" x 7/16" (T), 2" x 2-3/4" x 9/16" (R)  
Receiver Input: 5 vdc Output: Gated TTL Momentary Line

	Qty	1	5	10
RF60 Transmitter and Receiver Set		24.95	19.95	14.95

Add \$ 4 shipping for first item + \$ 1 for each additional item. Ca. residents add 8.25% tax  
Visa, Mastercard, Money Orders Personal Checks and Cash C.O.D.s

## Visitec Inc.

P.O. Box 14156 Fremont, CA. 94539 (510) 651-1425 Fax (510) 651-8454

CIRCLE 318 ON FREE INFORMATION CARD

## Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.00



## PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 \$198.00



### PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$89.00

### Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 \$99.00

Call for your FREE Catalog

# Graymark®

P.O. Box 2015 Tustin, CA 92781  
<http://www.labvolt.com>

CALL TODAY!  
**800-854-7393**



CIRCLE 329 ON FREE INFORMATION CARD

# FEATURING ... Network Accessories



## Network Cards

Software configurable Combo Network Card  
Network Certified and approved  
NE2000 jumperless

ISA 10 Base-T/2 combo card  
#TM-TBT-2000 \$21<sup>00</sup> ea.  
PCI 10 Base-T/2 combo card  
#TM-TBT-2PCI \$29<sup>00</sup> ea.  
PCI 100 Base-T combo card  
#TM-TBT-2100 \$54<sup>50</sup> ea.

## Build Your Own Cable

RJ-45 Crimp tool w/ stripper & cutter  
#TM-CR8 \$14<sup>00</sup> ea.  
RJ-45 Connectors 50 MICRONS GOLD  
#TE-MC8-T \$14<sup>00</sup> per 100pc. bag  
1000' Category 5 Cable UTP-Solid  
#TE-08C-TL5 \$99<sup>00</sup> / roll

## CATEGORY 5 CABLES

RJ-45 male to male  
UTP patch cable  
Gold plated RJ45 connectors  
Meets IEEE 802.3 specifications  
#TE-038-L5 3ft. \$2<sup>00</sup> ea.  
#TE-068-L5 7ft. \$2<sup>00</sup> ea.  
#TE-128-L5 14ft. \$4<sup>00</sup> ea.  
#TE-258-L5 25ft. \$5<sup>00</sup> ea.  
#TE-508-L5 50ft. \$11<sup>00</sup> ea.  
#TE-758-L5 75ft. \$18<sup>00</sup> ea.  
#TE-108-L5 100ft. \$20<sup>00</sup> ea.

-Crossover for connecting  
two computers w/out a hub  
#TE-068-L5X 7ft. \$3<sup>00</sup> ea.  
#TE-128-L5X 14ft. \$4<sup>00</sup> ea.  
#TE-258-L5X 25ft. \$6<sup>00</sup> ea.

## HUBS

Active hub-LED status indicators- Stackable units  
Complies with IEEE 802.3-10Mbps standard  
Use with UTP Ethernet networks  
5 port 10 Base-T  
#TM-TBT-HUB5 \$59<sup>00</sup> ea.  
8 port 10 Base-T  
#TM-TBT-HUB \$89<sup>00</sup> ea.  
16 port 10 Base-T  
#TM-TBT-HUB16 \$169<sup>00</sup> ea.

## Multi-Modular Cable Tester

Tests continuity for each pair.  
Includes unit for remote testing and carrying  
case.  
#TM-149 \$69<sup>00</sup>  
ALSO W/ BNC #TM-147 \$79<sup>00</sup>

# Roger's Systems Specialist

Order On-Line!

800-366-0579

**We Have Great Connections**  
Computer - Communications  
Network - Audio - Video  
[www.rogerssystems.com](http://www.rogerssystems.com)

Call for a  
FREE catalog!

## SVGA Shielded Cables

6 ft. HD 15 male to female  
#CC-VGA-4 \$3<sup>00</sup> each  
4/\$5.00

6 ft. HD 15 male to female  
Dual coaxial shield  
-helps with ghosting, line  
loss, and high resolution  
monitors

#CC-VGA-4C  
\$8<sup>00</sup> each

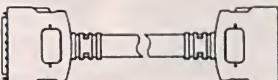
6 ft. HD 15 male to male  
switch box cable

#CC-VGA-3  
\$3<sup>00</sup> each

6 ft. HD 15 male to male  
switch box cable  
Dual coaxial shield  
-helps with ghosting, line  
loss, and high resolution  
monitors

#CC-VGA-3C  
\$8<sup>00</sup> each

## SCSI



## CABLES

SCSI 1 TO SCSI 1 CABLE  
50 pin Centronics  
male to male  
6 ft.

#CC-676  
\$7<sup>00</sup> each

SCSI 2 TO SCSI 1 CABLE  
HD50 to Centronics 50  
male to male  
6 ft.

#CC-686  
\$19<sup>00</sup> each

SCSI 3 TO SCSI 1 CABLE  
HD68 to 50 pin centronics  
male to male  
6 ft. w/ thumbscrews

#CC-687-6TS  
\$37<sup>00</sup> each

SCSI 3 TO SCSI 3 CABLE  
HD68 to HD68  
male to male  
6 ft. w/ thumbscrews

#CC-693-6TS  
\$39<sup>00</sup> each

SCSI 2 TO SCSI 2 CABLE  
HD50 to HD50  
male to male  
6 ft.

#CC-678-6  
\$36<sup>00</sup> each

SCSI 2 TO SCSI 3 CABLE  
HD50 to HD68  
male to male  
6 ft. w/ thumb screws

#CC-692-6TS  
\$36<sup>00</sup> each

DB25 TO SCSI 1 CABLE  
DB25 to 50 Centronics  
male to male  
6 ft.

#CC-670  
\$4<sup>00</sup> each

DB25 TO SCSI 2 CABLE  
DB25 to HD50  
male to male  
6 ft.

#CC-671-6  
\$20<sup>00</sup> each

DB25 TO SCSI 3 CABLE  
DB25 to HD68  
male to male  
6 ft.

#CC-697-6TS  
\$39<sup>00</sup> each

All cables available in 3 ft. lengths!

## Printer Cables

DB25 to 36 Centronics  
male to male  
#CC-PR6 6ft. \$3<sup>00</sup> ea.  
#CC-PR1 10ft. \$4<sup>00</sup> ea.

IEEE-1284 Compliant  
printer cables  
DB25 to 36 Centronics  
male to male

#CC-PR6-1284 6ft.  
\$8<sup>00</sup> each

#CC-PR1-1284 10ft.  
\$10<sup>00</sup> each

#CC-P15-1284 15ft.  
\$15<sup>00</sup> each  
#CC-PR2-1284 25ft.  
\$28<sup>00</sup> each

## Special I-EEE 1284 Printer Cable

10' Bi-Directional  
DB25 Male to Mini Centronic 36  
A.K.A. type "A" - "C"  
#CC-PR6-BIMIN  
\$.89 each

Local 805-295-5577

Remember, We Have Great Connections...For You!

FAX 805-295-8777

\$10.00 minimum order required • Add \$4.50 shipping for pre-paid orders  
California residents add 8.25% tax • eMail [Sales@RogersSystems.com](mailto:Sales@RogersSystems.com)

Call for quantity discounts • No out of state checks accepted • Most orders shipped same day

24895 Avenue Rockefeller, Valencia, CA 91355



## FRIENDLY LITTLE MICRO CONTROLLER

\$149  
(single)



...packs a **MEAN** punch  
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit)
- 128K SRAM + 128K Flash
- LCD/Keypad Interface
- Fast 16 bit Motorola CPU
- Affordable C Compiler
- Comprehensive s/w Library

\* Intec Automation Inc. v: 250-721-5150  
www.islandnet.com/~i11  
fx: 250-721-4191

## Printed Circuits in Minutes Direct From LaserPrint!

1. LaserPrint\*
2. Press On\*\*
3. Peel Off
4. Etch



Use Standard Copper Clad Board  
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100  
Visa/MC/PO/Ck/MO \$4 S&H  
Techniks Inc.  
P.O. Box 463  
Ringoes NJ 08551  
ph. 908.788.8249 fax 908.788.8837  
http://chelsea.ios.com/~techniks  
Retail Dealer Inquiries Invited

## UPGRADE YOUR COMPUTER!

TECHNOLOGY ASSOCIATES  
959 W. 5th St. • Reno, NV 89503  
(702) 322-6875 • Fax (702) 324-3900  
www.techass.com • sales@hoopware.com

Memory	Hard Drive	Modems
4MB 1x32 60 ns \$140	WD 1.7 Gb IDE \$150	33.6 Int USR Fax/Modem PNP \$130
8MB 1x32 60 ns \$220	WD 2.1 Gb IDE \$174	33.6 Ext USR Fax/Modem PNP \$130
16MB 1x32 60 ns \$320	WD 3.2 Gb IDE \$206	56k Int USR Fax/Modem w/voice \$225
32MB 1x32 60 ns \$600	WD 4.3 Gb IDE \$251	56k Int Motorola Data/Fax \$105
16MB 2x64 Sdram \$430	WD 6.4 Gb IDE \$318	
32MB 4x64 Sdram \$750	4.5 UW SCSI \$500	

CPU's	Video Cards	
AMD K6 200 \$200	256K ISA VGA \$24	Trident 8900 1Mb ISA SVGA \$32
AMD K6 233 \$200	Trident 9500 1Mb ISA SVGA \$32	Trident 9680 1Mb PCI SVGA w/MPEG \$38
Cyrix MX 165 \$100	Trident 9680 1Mb PCI SVGA w/MPEG \$38	Diamond Stealth 3d 2000 \$55
Cyrix MX 200 \$150	Diamond Stealth 3d 2000 \$55	
Intel Pent 200mhz \$300		
Intel Pent 233mhz \$425		
Pent-II 266 \$700		
Pent-II 300 \$900		

Motherboards	Miscellaneous	Controller Cards
Pentium Intel Triton2 TX \$12k DIMM \$100	1.44Mb FDD \$28	ISA Multi I/O IDE \$28
Pentium Intel Triton2 TX \$12k DIMM \$100	1.2Mb FDD \$55	1.2Mb FDD \$55
Pentium Intel Triton2 TX \$12k DIMM \$100	16x CD-ROM IDE \$90	16x CD-ROM IDE \$90
Pentium Intel Triton2 TX \$12k DIMM \$100	32x CD-ROM IDE \$105	PCI Adaptec 2940 SCSI-2 fast \$200
Pentium Intel Triton2 TX \$12k DIMM \$100	HP T3000 3.2gb tape backup \$105	
Pentium Intel Triton2 TX \$12k DIMM \$100	3-button serial mouse \$9	
Pentium Intel Triton2 TX \$12k DIMM \$100	101 keyboard \$16	
Pentium Intel Triton2 TX \$12k DIMM \$100		

NOTE: Prices are projections based on advertising lead times	
--	--

Prices and availability subject to change without notice.

**CALL FOR DAILY LOW PRICES!**

## ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
- plugs vertically into solderless breadboard for easy development
- BOOT/RUN switch for easy programming via PC serial port
- all I/O lines on dual row connector
- Complete modular prototyping system!
- Expansion accessories available!



For just US\$74.95, our Starter Package (AD11SP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC11E2, providing 2K EEPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of 'HC11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (use our modular accessories).

Visa • MasterCard • AmericanExpress • Discover

TECHNOLOGICAL ARTS

309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462  
1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2  
voice/fax: (416) 963-8996 www.interlog.com/~techart

## 5-Channel Logic Analyzer Jan. 1997 Electronics Now

Operates through your computer's printer port.

Three trigger modes

No Power Required

11 octave sample range

Save and Print Logic Displays

Surface Mount Components (inside connector)

Kit: \$50.00

Fully Assembled \$65.00

Specs:

No. Channels: 5

Sample Rate: 8-1 MHz

No. Samples: 5000

Display screens: 35

Timing Cursors: 2

Trig Thresh: 2-3 V

Timing Error: 5%

Uses:

Student Projects

Teaching Aid

General Testing

Production Testing

Serial Data Analyzer

Tech Sales / Demos

Field Testing

American MicroTech Inc 219-482-3896

http://home.sprynet.com/sprynet/amtech

E-mail: amtech@sprynet.com

## Make your own circuit boards at home!!

Don't project-board your electronics circuits. Afford-A-Board them!! Our complete line of circuit board manufacturing equipment lets you create professional single or double-sided circuit boards in your own home. We manufacture affordable, developing, etching and stripping tanks. Afford-A-Board is your source for 2-sided photo-sensitive copperclad board.

12x12 FR4 1 oz. DS \$15.99

Call for our low, low pricing on film, chemicals and drill bits.

## Afford-A-Board

P.O. Box 32613

Kansas City, MO 64171

Tel: (913) 385-1843

Fax: (913) 895-9330

(888) 454-1017

VISA/AMEX/MC/Cash COD/MO

# Quality Reconditioned TEST EQUIPMENT

## Hewlett-Packard 3586B

Selective Level Meter, makes carrier measurements to 32.5 MHz, voice channel measurements from 50 Hz to 100 kHz.



**\$850.00**

## Hewlett-Packard 8901B

Modulation Analyzer, frequency range 150 kHz to 1300 MHz, measures RF frequency and RF power, completely automatic, has RF rear panel connectors. Other options available.

**\$5,200.00**

## Hewlett-Packard 8903B

Audio Analyzer, 20 Hz to 100 kHz, low-distortion audio source, frequency counter, high performance distortion analyzer, ac/dc voltmeter, and SINAD meter. Options available.

**Special \$3,250.00**

## Hewlett-Packard 8657A Opt 002

Signal Generator, 100 kHz to 1040 MHz, 10 Hz resolution, +13 to -143.5 dBm into 50Ω, opt 002 rf connectors on rear panel.

**\$4,500.00**

## Hewlett-Packard 8657D

Signal Generator, 100 kHz to 1030 MHz analog range, standard AM/FM modulation, π/4 DQPSK modulation for NADC, PDC, and PHS. Pulse modulation, <3.2% error vector magnitude.

**\$10,000.00**

## Hewlett-Packard 3575A

Gain/Phase Meter, network measurements over a seven decade frequency range, 1 Hz to 13 MHz and 100 dB amplitude range. Options available.

**\$1,200.00**

## Hewlett-Packard 4934A

Transmission Impairment Measuring Set, level/frequency up to 110 kHz, noise and noise-to-ground, noise-with-tone and signal-to-noise ratio, three-level impulse noise, P/AR.

**\$3,200.00**

**(602) 483-6202 • Fax (602) 483-6403**

14455 North 79th Street, Unit #C • Scottsdale, Arizona 85260

**WANTED: USED TEST EQUIPMENT**

CIRCLE 235 ON FREE INFORMATION CARD

## Hewlett-Packard 1650A

Logic Analyzer, Timing: 100 MHz on all 80 channels, State: 25 MHz on all 80 channels, Memory 1 kbit/channel, HP-IB, "auto-scale" sets up parameter with the push of a button.

**\$1,995.00**

## Hewlett-Packard 1650B

Logic Analyzer, Timing: 100 MHz on all 80 channels, State: to 35 MHz for all 80 channels, Memory: 1 kbit/channel, HP-IB, supports most 8, 16 and 32 bit microprocessor.

**\$2,750.00**

## Hewlett-Packard 8642A

Synthesized Signal Generator, 100 kHz to 2.115 GHz, <-134 dBc/Hz SSB phase noise at 20 kHz offset, -100 dBc nonharmonic spurious, +20dBm maximum output level.

**\$19,995.00**

## Hewlett-Packard 8568A

Spectrum Analyzer, 1000 Hz to 1500 MHz, -137 dBm to +30 dBm amplitude range, features frequency counter accuracy, digital display, store and recall control settings, HP-IB.

**\$13,000.00**

## Hewlett-Packard 8568B Opt E96

Spectrum Analyzer, 100 Hz to 1500 MHz, resolution bw from 1 kHz to 3 MHz in a 1, 3, 10 sequence. Phase noise is 107 dBc. Amplitude is -135 to +30 dBm. Call for option information.

**\$19,750.00**

## Hewlett-Packard 5350B

Microwave Frequency Counter, 10 Hz to 20 GHz, sensitivity to -40 dBm, 1 GHz/s tracking speed, 60-ms acquisition time, 100 measurements/s

**\$4,375.00**

## Hewlett-Packard 334A

Distortion Analyzer, 5 Hz to 600 kHz range, measures total harmonic distortion down to 0.1% full-scale, residual noise below 25 μV, voltage measurement 300 μV to 300 V rms full scale.

**\$369.00**

## Narda 370 BNM Termination

Dc to 18 GHz, Power 5W, Type n, male.

**New \$20.00 each**

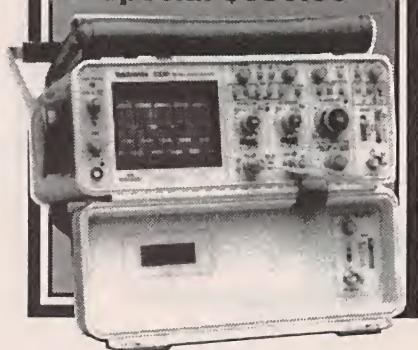
**or**

**10 for \$175.00**

## Tektronix 2336 Oscilloscope

Dc to 100 MHz bw, 5 mV/div to 5V/ div, 5 ns/div sweep rate, delta time on the flip cover. Includes 2 probes.

**Special \$850.00**



## Tektronix 2235 Oscilloscope

DC to 100 MHz bw, 2 mV sensitivity, 5 ns/div sweep rate, advanced trigger system, delayed sweep measurements, easy to use, lightweight, includes 2 probes.

**Special \$895.00**

## Hewlett-Packard 5370B

Universal Time-Interval Counter, 11 digits/s frequency, resolution, 20 ps single shot LSD, +100 ps accuracy achievable, frequency and period to 100 MHz, 8000 measurements possible, built-in stats functions.

**\$2,750.00**

## Tektronix 494P

Spectrum Analyzer, 10 kHz to 21 GHz, (capable of up to 325 GHz with external waveguide mixers, not supplied), nonvolatile memory storage, direct plot capability, keypad data entry.

**\$12,500.00**

**Bird 8327-300 . . . . . \$750.00**

Coaxial Attenuator, 30 dB, 1000 Watts, 50Ω.

**Bird 8329-300 . . . . . \$950.00**

Coaxial Attenuator, 30 dB, 2000 Watts, 50Ω.

**Bird 8890-300 . . . . . \$750.00**

Oil Dielectric load, 2500 Watt continuous.



**DANBAR  
SALES COMPANY**

## Find Bad Capacitors

In-Circuit  
with the  
Capacitor Wizard

The Capacitor Wizard is an extremely FAST and RELIABLE device designed to measure ESR (Equivalent Series Resistance) on capacitors of 1uf and larger "IN CIRCUIT", eliminating the need to remove the capacitor for accurate tests. The Capacitor Wizard finds BAD caps *IN CIRCUIT* that even VERY EXPENSIVE cap checkers MISS ENTIRELY, even out of the circuit!! Standard capacitor meters cannot detect any change in ESR therefore they miss bad capacitors leading to time consuming "Tough Dog" repairs. *Technicians say it is the most cost effective instrument on their workbench.*



Made in the USA  
Order Today

Only \$179.95  
Call 1-800-394-1984

<http://www.heinc.com>

Int. # 316-744-1993

Fax 316-744-1994

6222 N. Oliver, Kechi, KS 67067

30 day money back guarantee



BEST DEALER PRICING!

# CABLE DIRECT

CONVERTERS • FILTERS  
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH  
VIDEO STABILIZERS

FREE  
CABLE TV  
CATALOG!

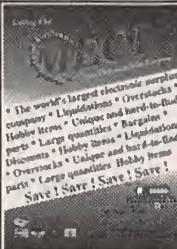
100%  
MONEY BACK  
GUARANTEE!

Now you can tune-in your favorite  
cable TV programming  
and **SAVE \$100'S** -  
**EVEN \$1000'S** on premium  
CABLE TV EQUIPMENT.



**MODERN  
ELECTRONICS**  
**1-800-906-6664**

2609 S. 156TH CIRCLE • OMAHA, NE 68130  
<http://www.modernelectronics.com>



Free Catalog

If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complementary 100 page catalog.

Why pay more? Call today.



340 East First Street Fax Order Line  
Dayton, Ohio 45402 1-800-344-6324

Order Toll-Free  
**1-800-344-4465**

CIRCLE 251 ON FREE INFORMATION CARD

MONDO • TRONICS'

# ROBOT STORE

\* KITS \*

Your

\* BOOKS \*

Mailorder

\* PARTS \*

Source

\* VIDEOS \*

For

\* MODELS \*

Robots!

\* MORE! \*

(REQUEST OUR FREE CATALOG)

[www.robostore.com](http://www.robostore.com)

**800-374-5764**

Or write to us:

4286 Redwood Hwy #226-137  
San Rafael CA 94903

Phone 415-491-4600 • Fax 415-491-4696  
Email [info@mondo.com](mailto:info@mondo.com)

# ALFA ELECTRONICS, INC.

1-800-526-2532 (526-ALFA)

HIGH QUALITY TEST EQUIPMENT PROVIDER

15 Days Money Back Guarantee!



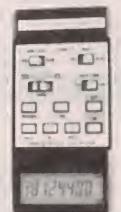
## DMM

- DMM-10 (\$19.95): 3 1/2 digit, DC/AC V, Ω, hFE, diode, signal output+3V, -0.5Vsq, 50% duty
- DMM-17B (\$39.95): 3 1/2 digit, DC/ACV, contin., DC/ACA, Ω, Capacitance, hFE, diode, Freq
- DMM-20 (\$74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
- DMM-22 (\$89.95): 4000counts, bar graph, Freq, AC/DC(V,A), Ω, Capacitance, diode, contin.
- DMM-23T (\$99.95): 4 1/2 digit, high resol. (10uV, 10nA, 10mΩ), hFE, diode, contin., true rms
- DMM-89S (\$179.00): true rms, AC/DC (V,A), bar graph, freq, capac., dBm, logic, diode
- DMM-113 (\$24.95): Pocket Size, DC/ACV, Ω, diode, Continuity beeper
- DMM-120 (\$24.95): economy type, DCV, ACV, DCA, Ω, hFE, diode
- DMM-122 (\$59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
- DMM-123 (\$44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
- DMM-124 (\$69.95): Electrical+Temp, DC/ACV, capacitance, freq, 3 phase, diode, contin.
- DMM-125C (\$54.95): Autorange + bar graph, DC/ACV, Cap, Ω, diode, continuity beeper



## LCR METER

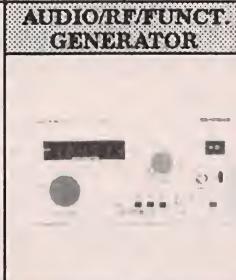
- CAP-15 (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.
- LCR-195 (\$89.95): 1uH-200H (induct.), 0.1pF-200pF(Capac.), 0.01Ω-20M Ω(resistance)
- LCR-814 (\$189.95): 0.1uH-200H, 0.1pF-20mF, 0.1Ω-20MΩ, Q Factor, dissipation, zero adjust
- LCR-131D (\$229.95): autorange, 0.1uH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/kHz testing mode



## FLUKE DMM

HandHeld	Scope Meter
12	\$84.95
70-II	\$75.95
73-II	\$97.95
75-II	\$129.00
76-II	\$175.00
77-II	\$155.00
79/29-II	\$175.00
87	\$287.00

## AUDIO/RF/FUNCT. GENERATOR



- FC-1200 (\$129.95): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz), 22mV (800MHz), batteries or 9V adapter.
- FC-2500 (\$179.95): 2.5GHz Handheld, 8 digits display, 4ppm accuracy, sensitivity <50mV, batteries or 9V adapter.

- FC-5270A (\$149.95): 1.2 GHz bench type, 8 digit, 10 ppm, 35mV sensitivity, 10Vp-p max. input, power by 9V adapter.
- FC-5700 (\$329.95): 1.3GHz bench type, 8 digit, 1 ppm accuracy, 20mV sensitivity, period 0.1us to 100ms. Ideal for test & repair of audio instrument.

## SPECIALTY

- Sound meter \$169.95
- EMF Tester \$69.95
- Conductivity \$169.95
- Thermometer \$69.95-\$89.95
- Humid./Temp meter \$169.95
- Press. meter \$299.95
- Electr. scale \$89.95
- Watt Meter \$129.95
- High Voltage Probe \$59.95
- pH Meter \$79.95
- Light Meter \$80-\$90
- Light Adapter \$49.95
- Anemometer \$179.95
- Anemometer adapter (And More) \$89.95

- RF Generator
- SG-4160 (\$124.95) 100kHz-150MHz sinewaves in 8 ranges, 100mV at 35MHz
- SG-4162 (\$229.95): Generate same signal as SG-4160, but with int. counter (150MHz).

### Audio Generator

- AG-2601 (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
- AG-2603 (\$229.95): Same as AG-2601, but with additional counter and digital display.

- Function Generator
- FG-2100A (\$169.95) 2Hz-2MHz, 5mV-20Vpp
- FG-2102AD (\$229.95) same as FG-2100A, but with int. counter and TTL, CMOS output.
- FG-2103 (\$329.95) Sweep 0.5Hz-5MHz, linear/log, VCG, GCV, and int. counter

## OSCILLOSCOPE

Dual Trace, Component Test, 6" CRT, X-Y Operation, TV Sync, CH2 Output, Graticule Illum, 2 Probes(x1,x10)

- PS-200 20 MHz Dual Trace \$339.95
- PS-205 20 MHz Dual w/ Delay Sweep \$429.95
- PS-400 40 MHz Dual Trace \$494.95
- PS-405 40 MHz Dual w/ Delay Sweep \$569.95
- PS-605 60 MHz Dual w/ Delay Sweep \$769.95
- PS-1000 100MHz Dual Trace \$999.95

### Digital Scope

- DS-303 30MHz Digital, 20 Samples/sec \$849.95
- DS-303P RS-232 interface, 30MHz \$1,049.95

### Scope Probe:

- HP-9060 (60MHz) \$15, HP-9150 (150MHz) \$22, HP-9250 (250MHz) \$29, HP-9258 (250MHz, 100:1) \$39

## Dual Tracking

- Short Circuit & overload protected
- Constant current, constant voltage mode
- 0.02%+2mV line regulation; 0.02%+2mV load regulation

### Digital Volt & Analog Current

- Analog Meters Display
- Digital Voltage, Analog Current

PS-303 (\$159.00) 30V/3A	PS-8200 (\$179.95) 30V/3A
PS-305 (\$219.95) 30V/5A	PS-8201 (\$239.95) 30V/5A
PS-8110 (\$289.95) 60V/5A	
PS-8112 (\$399.95) 60V/5A	Digital Volt & Current Display
PS-1610 (\$289.95) 16V/10A	PS-8300 (\$199.95) 30V/3A
PS-8107 (\$399.95) 30V/10A	PS-8301 (\$259.95) 30V/5A

### Digital Tracking (Analog & I Displays)

- PS-303D (\$314.95) 30V/3A/30V/3A
- PS-305D (\$399.95) 30V/5A/30V/5A
- PS-8108 (\$549.95) 60V/3A/60V/3A
- PS-8109 (\$699.95) 60V/5A/60V/5A

## Triple Output

- One fixed 5VDC, 3 Amp output
- Parallel to double current output (PS-8102 & PS-8103 only)

### Triple Output (Analog displays)

- PS-8102 (\$399.95) 30V/3A/30V/3A
- PS-8103 (\$489.95) 30V/5A/30V/5A

### Digital Display

- PS-8202 (\$499.95) 30V/3A/30V/3A
- PS-8203 (\$549.95) 30V/5A/30V/5A

## POWER SUPPLIES

### Single Output DC Power Supplies

- Short Circuit and overload protected
- Constant current, constant voltage mode
- 0.02%+2mV line regulation; 0.02%+2mV load regulation

### Analog Meters Display

### Digital Voltage, Analog Current

- PS-303 (\$159.00) 30V/3A
- PS-8200 (\$179.95) 30V/3A
- PS-305 (\$219.95) 30V/5A
- PS-8201 (\$239.95) 30V/5A

### Digital Volt & Current Display

- PS-8108 (\$549.95) 60V/3A/60V/3A
- PS-8109 (\$699.95) 60V/5A/60V/5A

## Dual Tracking

- Short Circuit & overload protected
- Constant current & constant mode
- Independent or Tracking

### Digital Tracking (Analog & I Displays)

- PS-303D (\$314.95) 30V/3A/30V/3A
- PS-305D (\$399.95) 30V/5A/30V/5A
- PS-8108 (\$549.95) 60V/3A/60V/3A
- PS-8109 (\$699.95) 60V/5A/60V/5A

## INSTEK®

### Test & Measuring Instrument

ISO 9002 Cert. #934163 (2 Years Warranty)

## OSCILLOSCOPE

OS-653 \$699.95 OS-622B \$399.95

30MHz Triggering

20 MHz Oscilloscope

20 MHz

5MHz One Channel

10 MHz One channel

## DC POWER SUPPLIES

### Triple Output

### Single Output

### Programmable

### Analog Meters Display

### Digital Volt & Current Display

### Digital Volt & Analog Current

### Digital Tracking (Analog & I Displays)

### Digital Volt & Current Display

### Digital Volt & Analog Current

# RS-232 Networkable Devices

Only 2 Wires are Required to Operate Most NCD Devices from a Single RS-232 Serial Port



Software included. Counts as 2 Devices on the NCD RS-232 Network. Combine up to 8 LCDAs on a Single Serial Line or mix with our relay drivers and other devices. Model described just \$299. Two other models available for \$199 and \$249.

Includes Drivers in QBasic, Mac & Amiga Software Also Supported.

RS-232

National Control Devices  
Contact Ryan Sheldon  
Phone: (404) 244-2432  
FAX: (417) 646-8302  
Include \$5 Shipping.  
Visa/MC Accepted.

NCD, Box 384, Osceola, MO 64776

Infrared Transceiver for Remote RS-232 Communication with 16 IR Controllable Devices. IRTR Kit \$24 Asm \$39  
RSB Serial Booster Gives your RS-232 Port the Power It Needs to Drive 16 NCD Devices. RSB Kit \$12 Asm \$24

On-Line Catalog: <http://members.aol.com/ncdcat/> E-mail: ncdryan@aol.com

CIRCLE 316 ON FREE INFORMATION CARD

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401  
(612)332-2378 FAX (612)332-8481 E-MAIL [SURP1@VISI.COM](mailto:SURP1@VISI.COM)  
WE BUY TEST EQUIPMENT AND COMPONENTS.

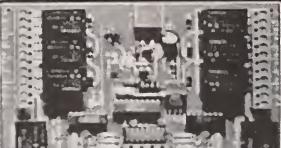
VISIT US ON THE WEB AT [WWW.ABCTEST.COM](http://WWW.ABCTEST.COM)

TEK 7B15 1 GHZ DELAYING TIME BASE	\$250.00	TEK 2245 100 MHZ 4 CHANNEL O-SCOPE	\$1200.00
TEK 2465A 350 MHZ 4 CHANNEL O-SCOPE	\$3200.00	TEK 7A19 600 MHZ SINGLE TRACE AMPLIFIER	\$150.00
TEK 7A26 200 MHZ DUAL TRACE AMPLIFIER	\$75.00	TEK 7B85 400 MHZ DELAYING TIME BASE	\$125.00
TEK 7904 500 MHZ MAIN FRAME	\$250.00	HP 1630D 25 MHZ LOGIC ANALYZER	\$250.00
TEK 577/177 CURVE TRACER	\$1500.00	TEK 7S11 SAMPLING PLUG IN	\$200.00
TEK 7S12 GENERAL PURPOSE SAMPLER	\$350.00	FLUKE 95 SCOPE METER NO PROBES	\$600.00
TEK 453 50MHZ OSCILLOSCOPE	\$200.00	FLUKE 97 SCOPE METER WITH PROBES	\$1000.00
DRAINETZ 626 DISTURBANCE ANALYZER	\$1500.00	HP 8182A 50 MHZ PATTERN GENERATOR	\$800.00
GENRAD 1657 RLC BRIDGE	\$750.00	PHILLIPS PM3296 400 MHZ OSCILLOSCOPE	\$1000.00
TEK 7D20 PROGRAMMABLE DIGITIZER	\$500.00	EMI SCR 7.5-300 7.5V 300A POWER SUPPLY	\$500.00
TEK 465 100 MHZ OSCILLOSCOPE	\$400.00	HP 8558B SPECTRUM ANALYZER	\$1500.00
TEK 465B 100 MHZ OSCILLOSCOPE	\$450.00	WAVETEK 175 WAVE FORM GENERATOR	\$500.00
TEK 2335 100 MHZ OSCILLOSCOPE	\$1200.00	WAVETEK 157 PROG. WAVE FORM SYNTH.	\$500.00
TEK 2215 60 MHZ OSCILLOSCOPE	\$350.00	RACAL DANA 1901 100 MHZ COUNTER	\$200.00
TEK 4961 1KHZ-1.8GHZ SPECTRUM ANALYZER	\$5000.00	VALHALLA 2790B SYSTEM INTERFACE	\$150.00
BRADLEY 132 SCOPe CALIBRATOR	\$700.00	GENRAD 1683 RLC BRIDGE	\$300.00
PHILLIPS PM3350A 60 MHZ DIG. STORAGE SCOPE	\$1000.00	HP 3455A MULTIMETER	\$300.00
HP 8601A 110 MHZ SWEEP/SIGNAL GENERATOR	\$400.00	HP 3456A MULTIMETER	\$450.00
TEK FG504 40 MHZ FUNCTION GENERATOR	\$500.00	FLUKE 5200A AC CALIBRATOR	\$1500.00
HP 54100A 1GHZ DIGITIZING OSCILLOSCOPE	\$3000.00	TEK TM504 4 SLOT POWER FRAME	\$125.00
HP 8170A LOGIC PATTERN GENERATOR	\$150.00	HP 4955A PROTOCOL ANALYZER	\$500.00
SYSTRON DONNER DPSD 50	\$500.00	MAGTROL 4614 POLYPHASE POWER ANLZR.	\$300.00
LEADER LSG215A 125 MHZ SIGNAL GENERATOR	\$700.00	TEK CT-5 HIGH CURRENT TRANSFORMER	\$500.00
SPECIAL THIS AD ONLY TEK 475 200 MHZ OSCILLOSCOPE			
SPECIAL THIS AD ONLY TEK DAS 9100 AS IS NO PROBES THESE UNITS ARE UNTESTED NOT REJECTS \$150.00			

180° Motion  
Multi-Power



8/16 Hobby Servo Controller. Futaba-J Compatible, Infrared Receiver Included with SV16 upgrade. Perfect in all animatronic applications.  
SV8 Kit \$39 Asm \$54  
SV16 Upgd Kit \$19 Asm \$29

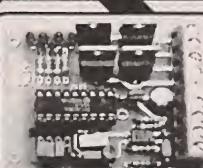


8-Relay Driver (Quad Relay Driver Available) includes 8 LED Status Lights. 12V Operation. Infrared Receiver With Omron Mech Relays.  
R85 (5A) Kit \$89 Asm \$139  
R810 (10A) Kit \$109 Asm \$159

NEW: RS-232 programmable 256x128 Graphic Display Module w/software controlled Backlight. Upload up to 128 BMP Image Files, animate at 960 frames/second, 16 level grayscale capability. Supports 32x16 Text overlayed with graphics. Documentation, Windows95 Setup Utility, and QBasic Example

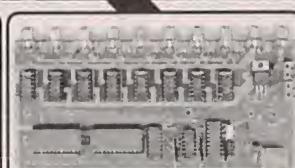
Software included. Counts as 2 Devices on the NCD RS-232 Network. Combine up to 8 LCDAs on a Single Serial Line or mix with our relay drivers and other devices. Model described just \$299. Two other models available for \$199 and \$249.

Combine 16 Devices in ANY Combination to Your RS-232 Port

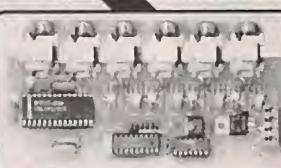


Leds Show Step Pattern.

High-Power Stepper Motor Controller for unipolar motors up to 12 volts 2 amps. Takes a step for every byte received. Control up to 16 steppers from 1 serial port.  
STP Kit \$24 Asm \$39



Audio/Video Switcher: 8 Inputs, 2 Outputs, Infrared Controllable, Routes Any Input to Any Output. 12-18 volt DC operation. For Low-Power (Line-Level) Signal Switching.  
AVS8 Kit \$89 Asm \$139



Audio Selector with 4 stereo inputs, 2 stereo outputs. Volume, Treble, Bass, Fader. Controlled by infrared or RS-232 w/Windows95 software. Fully NCD Networkable.  
NCD-ASP8X4 Asm \$79

KEEP YOUR C-BAND SYSTEM  
RUNNING STRONG!

Free Buyer's Guide

BEST VALUES ON...

- Receivers, including 4DTV
- Dish Movers & LNBs, all kinds
- Tune-up Kits, Tools & Parts
- Skypac® Programming
- Toll Free Technical Help

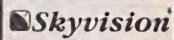


Fax: 218-739-4879

Int'l: 218-739-5231 1010 Frontier Dr.  
Fergus Falls, MN 56537

800-543-3025

[www.skyvision.com](http://www.skyvision.com)



THE SMART CHOICE

FOR OVER 47 YEARS,  
THE SERVICEMAN'S  
CHOICE FOR IN-  
VOICES AND SALES  
BOOKS HAS BEEN



OELRICH PUBLICATIONS.

- ⇒ QUALITY YOU CAN COUNT ON
- ⇒ PRICED AS LOW AS 4 CENTS EA.
- ⇒ COMPUTER FORMS AND CHECKS  
CALL TODAY  
FOR A FREE CATALOG  
1-800-621-0105

## CABLE TV CONVERTERS

Equipment & Accessories

Wholesalers Welcome

Call C&D ELECTRONICS

1-888-615-5757 M-F 10a-6p

Do You Repair Electronics?

Repair Databases for  
TV, VCR, Monitor, UL  
Audio, FCC, and more.

- Over 75,000 records
- Private user forums
- Live on-line chat rooms

[www.electronix.com](http://www.electronix.com)

Electronics Corp 313 W Main St. Fairborn, OH 45324 (937) 878-9878

# ARE YOU BEING "BUGGED?"

OUR FINEST

## Counter-Surveillance Device



THE ULTIMATE IN "BUG" DETECTION EQUIPMENT  
"DEBUGS" ROOMS AND TELEPHONES!

If you require GUARANTEED PROTECTION against electronic telephone monitoring devices and COMPLETE CONFIDENTIAL PRIVACY in certain rooms and areas, we highly recommend the COUNTER-SURVEILLANCE DETECTOR CSD-18.



### CONDUCT A PROFESSIONAL SEARCH...ANYTIME...ANYWHERE!

Every newspaper and magazine article and every radio and TV story discussing some new episode involving "Bugging" devices, continues to increase the ever growing demand for electronic Counter-Surveillance "sweeps" and equipment. The very limited supply of competently trained and equipped Counter-Surveillance specialists has created a situation where "sweep" rates exceeding \$250 per hour are now considered reasonable and appropriate.

This is an exciting, immensely interesting and profitable field that you can enter with a minimum investment. Two hours actual practice with the CSD-18 will have you "reading" and "clearing" telephones and rooms with professional ease and competence. The average fee for "debugging" a single telephone is over \$200.00. It requires about 45 minutes to complete the job and once it gets around that you can provide this service, you'll quickly have more clients than you can handle. Even if you choose to provide "sweeps" for only a small number of friends and associates, your initial investment will quickly be returned many times over.

### FREE WITH ORDER!

#### SUBMINIATURE "BODY WIRE" DETECTOR!

If you fear the possibility of being overheard and/or recorded during private conversations and require "silent" notification, we've also included our SBD-5 (regularly \$225) as a FREE GIFT! Only 3" x 2" x 1", this exciting new development in micro-minituarization will instantly detect hidden body wires at ranges up to 10 ft and alert you via a silent vibration.



**BIG MONEY OPPORTUNITIES!** Also, complete information describing the fantastic opportunities now open to trained Counter-Surveillance technicians and how a number of individuals are reaping a Bonanza in this booming business! You'll learn exactly how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, jealous suitors and unscrupulous business competitors, etc. has created huge demand for this service.

#### FASCINATING HI-TECH INFORMATION PACKAGE!

A detailed analysis of a variety of extremely fascinating hi-tech devices and procedures used for ultra-sophisticated audio and video eavesdropping including micro-wave and laser device monitoring; new methods for listening thru walls; all about scramblers, voice changers and exactly how neighbors eavesdrop. How missing persons are found, confidential data banks are broken into, lie detectors deceived and much more!

A comprehensive information package JAM-PACKED FULL of some of the most exciting and fascinating reading imaginable. Reads like a James Bond novel, with one important exception...IT'S NOT FICTION!

EVEN AS YOU READ THIS, countless individuals and firms are being enormously damaged by having their private conversations overheard, monitored, and/or recorded.

Almost without exception and AFTER the fact, the victims make a statement something along the lines of "But, I never thought it could happen to ME!"



#### EXTREME SENSITIVITY!

This is our finest piece of detection equipment! The CSD-18 quickly locates electronic eavesdropping devices in telephones, homes, offices, vehicles, boats, or concealed on the body. It will actually pick up many eavesdropping transmitters at ranges up to 25 ft! Extreme sensitivity is obtained via ultra-efficient amplification circuitry directly following the RF detection stages. Excellent quality dynamic headphones exclude all external sounds to further enhance detector output.

Encompassing an extremely wide-band frequency coverage of under 1 MHz to over 3 GHz, the CSD-18 quickly "homes-in" on any eavesdropping transmitter and immediately pinpoints its location. The closer you get to the "bug", the further the needle moves to the right. It's as simple as that.



FULL RANGE DYNAMIC HEADPHONES

#### "FLASHING" LED WARNS YOU INSTANTLY!

And, for maximum telephone security, the CSD-18 automatically analyzes a pre-programmed series of electronic measurements along the telephone line and converts the analysis into an easy to follow, step by step, test procedure. No technical knowledge is required or necessary. A visual indication (via a flashing LED) immediately reveals the presence of the various types of telephone "taps" and the flashing sequence identifies the actual type of eavesdropping device.



#### DETECTS THE LATEST "SUPER-BUGS"

Exclusive GSS proprietary circuitry assures the utmost privacy protection possible today. The CSD-18 detects even the very latest ultra-sophisticated eavesdropping devices specifically designed to defeat detection, including sophisticated "Frequency Hoppers" and "Burst Bugs". Also includes multi-line option for testing business phones.

#### MAXIMUM PROTECTION

The CSD-18 detects and locates ALL major categories of surveillance equipment including:

**BUMPER BEEPERS,  
"BODY" TRANSMITTERS  
TELEPHONE RECORDING DEVICES  
SERIES & PARALLEL PHONE TRANSMITTERS  
"INFINITY", MICRO-WAVE AND "LASER" BUGS  
& ALL TYPES OF CONCEALED TRANSMITTERS**  
including Video, Computer and Fax Transmitters

**CSD-18 \$495** Complete

Includes headphones, antenna/probe, all plugs and adapters, batteries, the Free SBD-5 & info Packages.

#### HOW TO ORDER

Order NOW by Mail or Telephone. 10 DAY MONEY BACK GUARANTEE if you're not 100% pleased and completely satisfied. We pay shipping charges on all prepaid & credit card orders. Add \$15 for CODs.

(C) 1995 **Great Southern Security**

513 Bankhead Highway  
Carrollton, GA 30117

**FOR FASTEST SERVICE CALL TOLL FREE**

**ORDER BY PHONE** **1 800 732-5000**



**VISA**

**MasterCard**

**Discover**

CIRCLE 315 ON FREE INFORMATION CARD

Interactive catalog: [www.tekview.com](http://www.tekview.com)

# TV cable CONVERTERS & EQUIPMENT

TekView Electronics



- \* 30 days money back guarantee
- \* 1 yr warranty
- \* Quantity Discounts
- \* Dealers Welcome!

# PIC Emulator

## PICE-6

from \$295

- Real-Time In-Circuit Emulator (up to 10 MHz)
- Supports PIC 16C62X, 16C6X, 16C7X, and 16C84
- Single step and run to Breakpoints
- Includes Assembler and Simulator
- 15 day money-back guarantee
- Programmer for PIC 16C5X, 16C6X, 16C7X, 16C84, and 17C4X in DIP packages, only \$155

## Learn 8051 On PC !

With our 80C552 SBC connected to your PC's printer port, learn to write the 8051 program, debug and test it on PC.

- 8051 core processor (80C552) with 8 channel 10-bit A/D and PWM
- 24 more I/Os and RS-232 port
- 32K ROM and 64K RAM
- Includes Assembler, Disassembler, real-time execution and debugging, plus monitor and example programs, only \$225

## ROMY-16 EPROM EMULATOR

Emulates ROM or RAM in 8- and 16-bit systems for \$195 (2716-27256) or \$245 (2716-27010). Window/menu driven interface. 15 day money-back guarantee. Optional assembler, disassembler, and ROM debugger, \$100 each CPU.

## LOW COST Microcontroller Development Systems

80C552, 80C31, and 68HC11 development systems include single board computer, assembler, disassembler, real-time execution and debugging, plus monitor and example programs.

## Universal Microprocessor Simulator/Debugger

Assembler, Disassembler, and Simulator for popular 8-bit CPUs.

## J&M Microtek, Inc.

83 Seaman Road, W Orange, NJ 07052  
Tel: (973)325-1892 Fax: (973)736-4567

## EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- [www.m2l.com](http://www.m2l.com)

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and Flash (28F, 29C) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

### Available Adapters

EP-PIC (16C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC64 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMS)	\$49.95
EP-28 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC722-10, 18, 8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMS)	\$49.95
EP-SOIC (SOIC EPROMS)	\$49.95
Many Other Adapters Available	

**M2L Electronics**  
310/837-7818 Fax/BBS: 310/841-8050  
3526 Jasmine #4; Los Angeles, CA 90034  
CA orders add 8.25% sales tax.  
<http://www.m2l.com>



Quality Microwave TV Systems  
WIRELESS CABLE - ITFS - MMDS  
ATV - INTERNATIONAL - S-BAND  
Amplifiers • Antennas • Books • Components  
Filters • Systems • Video Products  
• RF Frequency 1990 - 2700 MHz  
• Cable Ready - VHF - UHF Outputs  
• SASE For "FREE" Catalog or Send \$1  
PO Box 8533 - Scottsdale, AZ 85252

CHALLENGER SYSTEM  
33-Channel 52dB Gain  
Complete Grid #265

Five Year Warranty  
FREE SHIPPING

ORDER LINE 800-880-MMDS  
CATALOG / INFO 602-947-7700  
FAX LINE 602-947-7799

Visa • M/C • Amx • Disc • COD's • Qty Pricing

## The Electronic Experimenter's Journal

It's part catalog, part magazine and part data book with kits, parts, plans, articles, and application notes.

Call for your **FREE**  
copy today

Debco Electronics  
4025 Edwards Rd.  
Cincinnati, OH 45209

1 800 423-4499

## !!!BROADCAST FARTHER!!!

The model 220 is an 80-110 MHz RF amplifier that connects to mono or stereo FM transmitters and produces a powerful 2-15 watt signal which could broadcast up to 5 miles or more! Requires 50-150 mW drive. Step by step plans complete with part source **\$14** PLUS \$2 S&H NO C.O.D.s

**Progressive Concepts**  
PO Box 586 STREAMWOOD, IL 60107  
(630)736-9822 FAX:(630)736-0353



## Smithy / 3-in-1 Lathe•Mill•Drill

### Benchtop machine shop

- Make your own parts and repairs
- Easy to use, free training
- Work metal, wood, or plastic

Dept. EN, PO Box 1517  
Ann Arbor, MI 48106-1517  
Call 1-800-345-6342

4 models  
starting at

**\$995**

## SURVEILLANCE HIDDEN CAMERAS DIRECT FROM MANUFACTURER-BEST PRICE IN THE MARKET



Ultra minimum hidden camera, in dome, smoke or motion detector. B/W or Color Wide View angle. Low light sensitivity + super sharp Images, plus video and audio output. From \$159.00. Also 1/3" B/W board Cameras while, only \$99.00 USD. Wireless hidden camera, start at only \$249.00 USD. Plus \$5.95 for S.H. Whole/Retail Welcome, COD, Check, Money Order or Visa/MC.

**BOLIDE INTERNATIONAL CORPORATION**  
PH: (800) 355-0895 or (818) 575-8178  
9660 Flair Drive #318, El Monte, CA 91731  
<http://www.bolideamazingproducts.com>

## CABLE TV CONVERTERS

Equipment & Accessories  
Wholesalers Welcome

Call C&D ELECTRONICS  
1-888-615-5757 M-F 10a-6p

Electronics Now, March 1998



To learn more about life-saving techniques,  
call your Red Cross.



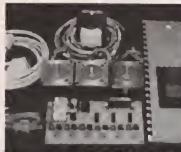
**3 Axis Motion Control System****Complete, ready to run****\$ 255.50 + 12.00 S/H**

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables, Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information,  
phone or write to:

**MAXNC**

6509 W. Frye Rd. Suite 3  
Chandler AZ 85224  
Ph (602) 940-9414  
Fax (602) 940-2384

**SURVEILLANCE TRANSMITTER SCHEMATICS!**

FM band- 2 telephone and 3 room transmitters constructed using Radio Shack parts with their numbers given. One telephone and two room transmitters are tunable from 65 to 305 MHz, and constructed with listed supply house parts. PC board patterns presented. **PRICE:** \$25.00 + S&H \$2.00. For immediate shipment, pay with money order.

**SHEFFIELD ELECTRONICS CO.**

P.O. Box 377940-C  
Chicago, IL 60637-7940  
Tel: (773) 324-2196

**STRANGE BOOKS!  
for Mad Scientists!**

Unusual, detailed how-to books, manuals, references, old & new, for experimenters and



mad scientists on high voltage, crystal sets, early radio and television, vacuum tube gear, Tesla, plastics, chemistry, hydrogen fuel, lasers, whiskey, solar cells, embalming, telegraphy, more! Highest quality! Guaranteed! Write (or send Igor) for big illustrated catalog! <http://www.keynet.net/~lindsay> fax: 815/935-5477

**Lindsay's Technical Books**  
PO Box 538-EBE, Bradley IL 60915

**Cable TV  
Converters**

**\$ A V E** *Dealers*  
**\$100s** *Welcome*

30 Day Money Back Guarantee

**Call Us Last!**

*We will beat any advertised price*

*CD Electronics*

*No 3C Sales*

**1-800-842-9670**  
<http://www.cdelectronics.com/cd>

**PC - Based Test Instruments  
For Automatic Testing  
at Bench-Top Prices**

- Instrument-on-a-card to plug into PC slot, and turn PC into a test station for automatic testing.
- An operation program included with instrument card, no need for extra software.
- No IEEE488 or RS232 hassle.

<b>100 MHz Dual Universal Counter</b>	.....	<b>\$399</b>
<b>6 MHz Function/Sweep Generator</b>	.....	<b>\$549</b>
<b>60 MHz Digital Storage Scope</b>	.....	<b>\$749</b>
<b>100 MHz Digital Storage Scope</b>	.....	<b>\$999</b>

*For spec and to download demo : [www.tcinst.com](http://www.tcinst.com)*

**TC** INSTRUMENTS INC.®

29 Chaparral Dr., Pomona, CA 91766, USA • Tel: (909) 622-2006 • Fax: (909) 622-7778

**ATTENTION DEALERS: WHOLESALE ONLY!**

Formerly JES, Inc.

**BEST PRICES!**  
**FAST SERVICE**  
**SAME DAY SHIPPING**

**EXCLUSIVE:**



**NEW!**

**Wavemaster 99 Channel**

• Sleep Timer • Std./HRC Switch • Parental Control

<b>10+</b>	<b>20 +</b>	<b>50 +</b>
<b>\$57</b>	<b>52</b>	<b>45</b>

<b>5+</b>	<b>10 +</b>	<b>20 +</b>	
Panasonic 145	\$72	65	60
Refurb. Panasonic 145	57	55	52
Panasonic 100	52	49	--
Panasonic 175	---	CALL!	---
Starcomm DQN (99 ch; Refurb.)	49	45	39

**TOLL FREE:**  
**800-322-9690**



**FAX:**

**516-246-5634**

# USE ELECTRONICS NOW CLASSIFIEDS

READ BY ELECTRONIC BUYERS AND SELLERS AND TRADERS

## INSTRUCTIONS FOR PLACING YOUR AD!

### HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but in all cases, full payment must accompany your order.

### WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

### RATES

Our classified ad rate is \$2.50 per word. Minimum charge is \$37.50 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface** (not available as all caps), add .40 per word additional. Entire ad in boldface, add 20%. **Tint screen behind entire ad**, add 25%. **Tint screen plus all boldface ad**, add 45%. **Expanded type ad**, add \$4.00 per word.

**General Information:** A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

### DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. ELECTRONICS NOW is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

### CONTENT

All classified advertising in ELECTRONICS NOW is limited to electronics items only. All ads are subject to the publishers' approval. **WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.**

**AD RATES:** \$2.50 per word, Minimum \$37.50

Send you ad payments to:

ELECTRONICS NOW 500 Bi-County Blvd, Farmingdale, NY 11735-3931

### CATEGORIES

100 -- Antique Electronics	270 -- Computer Equipment Wanted	450 -- Ham Gear Wanted	630 -- Repairs-Services
130 -- Audio-Video Lasers	300 -- Computer Hardware	480 -- Miscellaneous Electronics For Sale	660 -- Satellite Equipment
160 -- Business Opportunities	330 -- Computer Software	510 -- Miscellaneous Electronics Wanted	690 -- Security
190 -- Cable TV	360 -- Education	540 -- Music & Accessories	710 -- Telephone
210 -- CB-Scanners	390 -- FAX	570 -- Plans-Kits-Schematics	720 -- Test Equipment
240 -- Components	420 -- Ham Gear For Sale	600 -- Publications	730 -- Wanted

### CLASSIFIED AD COPY ORDER FORM

Place this ad in Category # \_\_\_\_\_

Special Category \$30.00 Additional \_\_\_\_\_

1 - \$37.50    2 - \$37.50    3 - \$37.50    4 - \$37.50

29 - \$72.50    30 - \$75.00    31 - \$77.50    32 - \$80.00

5 - \$37.50    6 - \$37.50    7 - \$37.50    8 - \$37.50

33 - \$82.50    34 - \$85.00    35 - \$87.50    36 - \$90.00

9 - \$37.50    10 - \$37.50    11 - \$37.50    12 - \$37.50

37 - \$92.50    38 - \$95.00    39 - \$97.50    40 - \$100.00

13 - \$37.50    14 - \$37.50    15 - \$37.50    16 - \$40.00

Total words \_\_\_\_\_ \$2.50 per word = \$ \_\_\_\_\_

17 - \$42.50    18 - \$45.00    19 - \$47.50    20 - \$50.00

Bold Face \_\_\_\_\_ \$0.40 per word = \$ \_\_\_\_\_

21 - \$52.50    22 - \$55.00    23 - \$57.50    24 - \$60.00

Special Heading \_\_\_\_\_ \$30.00 = \$ \_\_\_\_\_

25 - \$62.50    26 - \$65.00    27 - \$67.50    28 - \$70.00

Other \_\_\_\_\_ = \$ \_\_\_\_\_

Total classified ad payment \$ \_\_\_\_\_ enclosed

**TOTAL COST OF AD \$ \_\_\_\_\_**

Check     Mastercard     Visa     Discover    Card # \_\_\_\_\_ Expiration Date \_\_\_\_ / \_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_ City State Zip \_\_\_\_\_

Mark V Electronics, Inc.  
8019 E. Slauson Ave.,  
Montebello, CA 90640

Catalog 213/ 888-8988  
Fax 213/ 888-6868  
http://www.mark5co.com  
Email: mark5co@aol.com

DIY Audio Electronic Kits  
Lab Equipment Kits  
Audio Enclosures & more!

ORDER  
1-800-521-MARK  
1-800-423-FIVE

Kit skill levels

Beginner  
Intermediate  
Advanced

- Fast Shipping  
- Quality Kits low prices  
- In business since 1985

SCHOOL PROJECT CORNER  
po orders welcomed from schools

Melody Generator	Kit	\$ 13.85
6V Mini-Amplifier	▲	9.50
0-15V 5A Regulated DC PS	▲	17.50
36W Class A Power Amp.	▲▲	32.50
Dynamic Noise Reduction	▲	26.00
Multi-Function Control Switch	▲	10.50
20 Bar/Dot Level Display	▲▲	41.45
Microphone Mixer Mono Amp.	▲	20.79
Superior Electronic Roulette	▲	21.50
Digital Clock with Melody Alarm	▲	25.00
Stereo Pre-Amp with Mic Amp.	▲	10.78
Mini Stereo Multi-Input Amp.	▲	30.50
130-in-one Electronic Lab	▲	29.99

SEE OUR CATALOG FOR MORE KITS!

Clearance Sale

FM Wireless Microphone

This is a low power real FM transmitter. Transmit frequency within 88-108 MHz. Transmit range about 200 ft. It has high sensitivity sound pickup by a capacitance microphone. May be used strictly for series purposes such as remote wireless monitoring.

Kit \$ 12.50 6.99

20 Color LED Level Meter

Clearance Sale

Kit \$ 20.15 9.99

Use this dual LED display indicating meter with your stereo power amplifier to indicate instantaneous speaker power. Operating range is -30dB to +5dB and can be calibrated to operate with 1 to 200 W amplifiers. Not consume any amplifier power. A peak LED illuminates on overload!

Stereo Loudspeaker Protector

TY-25 ▲



Super fast acting relay protects speakers against destructive DC voltages. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumps.

Kit: \$ 16.75

Regulated DC Power Supply

TR-503 ▲



It is short circuit proof & has overload protection. Output voltage is variable over a range of 0-50 volts. Current limit trip is adjustable up to max of 3A. May use Mark V #002 transformer.

Kit: \$ 18.75

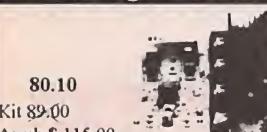
120-250W Mosfet Power Mono Amplifier AF-2 (6 lbs.) ▲▲



Power Output: 250W into 4 ohms RMS (42VX2 6A transformer is used). 120W into 4 ohms RMS (33VX2 4A transformer is used). Frequency Response: 3Hz-22,000Hz. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47K. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. May use Mark V model 012 Transformer. Suggested Capacitor 8,200uf 100V Model 020. Suggested Metal Cabinet LG-1925.

Kit: \$ 89.80 80.82 Asmb.\$ 114.80

300W High Power Mono Amplifier TA-3600 (5 lbs.) ▲▲



Power Output: 300W into 8 ohms RMS. 540W music power into 8 ohms. Frequency Response: 10Hz-20KHz. THD: < 0.05%. Sensitivity: 1V RMS at 47K. Power Requirement: 60 to 75 VDC at 8A. May use Mark V Model 007 or 009 Transformer. Suggested Capacitor: 8,200uf 100V Model 020 Capacitor. Suggested Metal Cabinet LG-1925.



120W + 120W Pre & Main Stereo Amplifier TA-800MK2 (4 lbs.) ▲▲

Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10 - 20 KHZ. THD: < 0.01%. Tone Control: Bass ±12dB, Mid ±8dB, Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Metal Cabinet Model LG-1924.

Kit: \$ 67.92 Asmb.\$ 86.95

80W + 80W Pure DC Stereo Main Power Amplifier TA-802 (4 lbs.) ▲▲



Power Output: 80W per channel into 8 ohms. THD: < 0.05%. Frequency Response: DC to 200 KHZ, -0 dB, -3dB @ 1W. Power Requirement: 30V AC X 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924



30W + 30W Pre & Main Stereo Amplifier TA-323A (1 lb.) ▲

Power Output: 30W into 8 ohms RMS per channel. THD: < 0.1% from 100 HZ to 10 KHZ. Sensitivity: Phono 3mV @ 47K Tuner, Tape 130mV @ 47K. Signal to Noise ratio: 80dB. Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.

Kit: \$ 32.50 Asmb.\$ 50.50

Metal Cabinets  
Aluminum Front Panel

LG-1273 3x12x7" (4 lbs.) \$ 26.50  
LG-1684 4x16x8" (7 lbs.) 32.50  
LG-1924 4x19x11½" (10 lbs.) 38.25  
LG-1925 5x19x11½" (10 lbs.) 42.00  
LG-1983 2½x19x8" (7 lbs.) 35.25

Transformers (5-12 lbs.)  
Toroidal Transformers

# 001	28V/30V x2	6A	\$ 30.00
# 002	36V x2	3A	25.00
# 003	40V x2	6A	32.00
# 008**	28V/30V x2	6A	42.00
# 009**	48/53V x2	8A	68.00
# 012**	33/40/42V x2	6A	52.00

60+60W Stereo Power Amp. ▲

SM-302 (11 lbs.) It provides 3 input jack pairs. One pair accept a high impedance microphone. The two remaining pairs are for high & low level input

Kit: \$ 85.00  
sources. Power Output: 60W per channel into 4 ohms RMS. 20Hz-20KHz THD:<0.1%. Input Sensitivity :Mic /Guitar 10mV, Hi 380mV, Lo 640mV. Ready to plug in when assembled.

300-in-one Electronic Lab Kit ▲

Learn about transistors, capacitors & electronic circuits. Build electronic games, battery checker & more. It even includes a breadboard for adding your own components. Complete with easy-to-follow manual. Requires 6 "AA" batteries. (6 lbs.)

Best Buy



\$ 59.99 49.99

Minimum order: \$ 20.00. We accept Visa, MasterCard, Money Orders, and Checks(allow 2 weeks for clearance). We ship by UPS ground inside US (min \$6.00) and ship by US mail outside US. Please call our operator for orders over 2 lbs. or foreign orders.

CIRCLE 331 ON FREE INFORMATION CARD

# The Only 100% Legal, FCC approved, DESCRAMBLER you can buy!

## NAVIGATOR III...

*The only legal way to own your converter!*

- 250 Channel Capacity
- Subscribe to two different cable systems simultaneously
- Interactive On-Screen Display
- Watch one premium channel while recording another
- Electronic program guide shows all programming over next 7 days
- One Touch Recording



NO RENTAL FEES!  
Advanced  
Features!

Most advanced  
set-top you  
can buy!

Save  
Money!

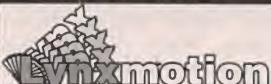
FCC & UL Approved

**DYNAMIC Technologies • Phone: 402-731-9555**

Suite 541064 • Boystown, NE 68154

CIRCLE 312 ON FREE INFORMATION CARD

### Micromouse Robot Kit \$95.00



Build your own functional Micromouse Robot

The kit comes complete with all hardware, structural components, 2 Hitec servos, Counterfeit Basic Stamp kit, software and an illustrated assembly manual. This robot is an excellent foundation for many experiments such as; obstacle avoidance, maze negotiation, computer art and line tracking. Designed for smooth surfaces. It is a lot of fun to build and even more fun to operate. Check out our web site for more information and other robot kits.

• Line Tracker Option \$20.00

• Servo 6 Pack \$80.00

• Mobile Robots Book \$48.00



Quantity discounts available. \$7.50 Shipping & Handling for USA, call for International and  
monthly shipping charges. IL residents add 6.25% sales tax to total.

Many more robot kits, ask for our free catalog!

Technical Service & Solutions  
104 Partridge Road

Pekin, IL 61554-1403 USA



Tel: 309-382-1816  
Fax: 309-382-1254  
[www.lynxmotion.com](http://www.lynxmotion.com)  
jfrye@lynxmotion.com

### Precious Life

This nurse was once a patient at St. Jude Children's Research Hospital. She fought a tough battle with childhood cancer. And won.

Until every child can be saved, our scientists and doctors must continue their research in a race against time. To find out more, write St. Jude Hospital, P.O. Box 3704, Memphis, TN 38103, or call 1-800-877-5833.



ST. JUDE CHILDREN'S  
RESEARCH HOSPITAL  
Danny Thomas, Founder



## 0-135 VDC 15 A Supply

PP-1459A BATTERY CHARGER, used to charge storage batteries; produces unregulated 0-135 VDC 15 amp output from 115/230 VAC 50-60 Hz 15 amp input. Has 2.5" dia meters 0-150 VDC and 0-20 amps DC, Coarse & Fine 12-step controls, plus 115/230 V Input selector. Input - Output each have circuit breaker; with power cord. 12x11x12, 60 lbs sh. USED, \$49.50

## DIODE ASSEMBLIES

DIODE HEATSINK ASSEMBLY, six 1N3085 100 PIV 150 amp diodes on 1.9x9.3x4.8 heatsink, 4 lbs sh. #DHS6-3085, ..... \$24.95



#DHS6-5A10P, with six Sarkes ST5A10P 100 PIV 50 amp diodes; heatsink 2.6x8x4.5, 3 lbs sh. ..... \$12.95

#DHS6-1815, with six MR-1815-SL 300 PIV 100 amp diodes; heatsink 2.6x9.4x4.8, 4 lbs sh. ..... \$32.95



**BOX KITE** designed for lifting wire antenna or other pleasure. Has 15" Wx12" H distress orange plastic poly-vinyl panels on metal frame. Stands overall 36" H x 15" square; sturdy frame can be re-covered with silk or similar light fabric. Includes panel repair kit; 3 lbs sh. #SEB-42ABK, unused, \$24.00

## Antenna - Tether Wire

306 FOOT SPOOL of vinyl-covered braided #22-size antenna wire intended for use with above kite or with balloon; usable as long-wire antenna also. On spool; 3 lbs sh. #SEB-400X3, unused, \$12.95



Prices F.O.B. Lima, Ohio. VISA, MASTERCARD accepted. Allow for shipping charges. Write for latest Catalog. Address Dept. ES + Phone 419/227-6573 + FAX 419/227-1313 E-mail: fairadio@wcoll.com Home Page: <http://alpha.wcoll.com/~fairadio/>

## FAIR RADIO SALES CO.

1016 E. Eureka + Box 1105 + Lima, Ohio 45802

**Weeder**  
Technologies

Add \$4  
Ship/Hand  
US & Canada

PO Box 2426, Ft. Walton Beach, FL 32549

### Stackable RS-232 Kits

**Digital I/O** - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 18 modules on same port for 182 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. \$32.00

**Analog Input** - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. \$49.00

**Home Automation (X-10)** - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection and auto re-transmission. \$38.50

**Caller ID** - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: '12/31 08:45 850-863-5723 Weeder, Terry <CR>'. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. \$34.50

**Touch-Tone Input** - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. \$33.50

**FREE  
CATALOG!**



**Pro-Kit**  
850-863-5723

### Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have 'not' been entered.

Block out selected outgoing calls. Bypass at any time using your password. \$35.00

Block out selected incoming calls. Calls identified using Caller ID data. \$48.00

### Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. 'Dial-Out' pin instructs unit to pick up phone and dial user entered number(s). Password protected. \$49.00

### IR Remote Control Receiver

Learns and records the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either 'toggle' or 'momentary' action. \$32.00

### DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. \$54.50

**ACTIVE  
MICRO**

**WE WANT YOUR  
EXCESS INVENTORY**

- INTEGRATED CIRCUITS
- MEMORY (NEW OR USED)
- EPROMS (NEW OR USED)
- PALS
- GALS (NEW OR USED)
- BOARDS (WITH MEMORY)



TEL: 562-494-4851 FAX: 562-494-4913

1891 OBISPO AVE SIGNAL HILL, CA 90804

## LASERS

### AT GREAT PRICES

Complete Ruby Laser Assembly less than \$300  
He-Ne Lasers, complete, for less than \$50  
American 60X Argon Lasers from \$595  
Laser Diode Modules from under \$40  
X-Y Scanners from \$79

### FREE CATALOG

- Helium-Neon
- Argon Lasers
- Diode Lasers
- Holography
- Books
- Ruby Lasers
- Scanners
- Lightshow Equipment
- Pointers
- Optics

Email: [mlp@nlenx.com](mailto:mlp@nlenx.com) <http://www.midwest-laser.com>



**Midwest Laser Products**

30 Day Satisfaction  
Guarantee.  
VISA / MC Accepted

P.O. Box 262, Frankfort, IL 60423

Phone: (815) 464-0085 FAX: (815) 464-0767



The Smallest\*, Lightest\*, Coolest, 5% Regulated, 10 Watt DC Power Supplies are here!

\* 1.9 x 2.1 x 1", 2.9 oz. Tiny, aren't they?

VDC @ Amps

5.0	1.6
9.0	1.1
12.0	0.8

\$29.95

SINGLE Qty. US\$

+ NEXT DAY or 2 DAY AIR



Detailed Specs on web site!  
[www.plugpwr.com/alpha.htm](http://www.plugpwr.com/alpha.htm)

CALL FREE IN US & Canada:

1-888-PLUGPWR  
(1-888-758-4797)

## Make Life Easy!

### Program these PICs in BASIC:

12C671, 12C672, 14000,  
16C554, 16C556, 16C558,  
16C620, 16C621, 16C622,  
16C62, 16C63, 16C64, 16C65,  
16C71, 16C72, 16C73, 16C74,  
16C84, 16F83, 16F84, more.



BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.

- Expanded BASIC Stamp I compatible instruct's
- True compiler provides faster program execution and longer programs than BASIC interpreters

PicBasic Compiler - \$99.95

PicBasic Compiler Bundle - \$179.95

Includes: PicBasic Compiler, EPIC Programmer, AC Adapter, Cable, PICPro18 and PIC16F84.

\*BASIC Stamp is a trademark of Parallax, Inc.

**microEngineering Labs, Inc.**  
Box 7532 Colorado Springs CO 80933  
(719) 520-5323 fax (719) 520-1867  
<http://www.melabs.com>



## Cable TV Outlet



Get the Clearest Coverage of Sports, Movies, News, Main Events and Adult!

-Unbeatable Wholesale Pricing-  
-Converters/Descramblers-  
-Filters and Accessories-  
-Premium Channel Coverage-  
-Full Satisfaction Guaranteed-

**QB VIDEO**

Open M-F 9a to 5p (CT)

**1-800-249-3025**

Visa, MC & C.O.D.'s Welcome

# CLASSIFIED

## MISCELLANEOUS ELECTRONICS FOR SALE

PIECE parts for Delco OEM radios. Low pricing. Factory Original. No subs. Call today, 1 (800) 433-9657.

## PLANS-KITS-SCHEMATICS

FREE Catalog, 100 Leading-Edge kits. K1, PIC. Full instructions, source code. 1 (800) 875-3214. SCIENCE FIRST, 95 Botsford Place, Buffalo, NY 14216.

ELECTRONIC Project Kits. [www.qkits.com](http://www.qkits.com) 1-888-GO-4-KITS. 292 Queen St., Kingston, ON, K7K 1B8. QUALITY KITS.

TUBES: "oldest", "latest". Parts and schematics. SASE for lists. Steinmetz Electronics 7519 Maplewood Ave., Hammond, Indiana 46324.

## CABLE TV

NEW! Jerrold and Pioneer wireless test units \$125.00 each, also 75DB notch filters \$19.95 each, quantity pricing available. Please call KEN ERNY ELECTRONICS, 24 hour order and information hot line (516) 389-3536.

CABLE descramblers and converters 10 lot decoders \$38.00 ea. 10 lot converters \$57.00 ea. Visa and Mastercard accepted. (304) 337-8027.

MAESTRO latest technology. Compatible with all major systems: Pioneer, Jerrold, Scientific Atlanta, Zenith. Universal descrambling capabilities. Dealers wanted. Money back guarantee. 1 (800) 676-7966.

CABLE TV Descramblers. One piece units. Pioneer, 6310's Scientific Atlanta 8580's Dpv 7's and others. Lowest prices. Money back guarantee. PRECISION ELECTRONICS Houston, TX. 1-888-691-4610.

Free Cable Descrambler Plans. For Details Write: Sierra Publishing, 909 E. Yorba Linda Blvd., Suite H-181, Dept. ENO, Placentia, CA 92870

Signal Eliminator can block severe TV interference or unwanted channels! Visit us on the web today at <http://starcircuits.com/tvfilter>. Request a free brochure by mail or voicemail. Star Circuits, PO Box 94917, Las Vegas, NV 89193. 1-800-433-6319.

CABLE TV major brands including ZENITH ST. 1600 \$249.00 New Zenith add-on TVT \$70.00 WHOLESALERS WELCOME 1-800-822-8530

CABLE test modules/cubes. Pioneers, S/A, Tooms, Jerrold, Quantity discounts, Call DCR: Tel: (718) 624-8334 Fax: (718) 246-9731 No NY calls.

CABLE DESCRAMBLING, NEW SECRET MANUAL. Build your own Descramblers for Cable and Subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2.00 postage. CABLETRONICS, Box 30502R, Bethesda, MD 20824.

NEW! Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, converter boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$99.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

Descramble cable with simple circuit added to Radio Shack RF Modulator and using VCR as tuner instructions \$10.00 TELECOM Box 832-E2 Brushy, LA 70719.

CABLE TV, DESCRAMBLERS, CONVERTERS QUANTITY DISCOUNTS, LOW LOW PRICES 30 DAY-MONEY BACK GUARANTEED. CALL NOW 888-898-3284 SKYLAB SALES INC.

WHOLESALE CABLE WAREHOUSE Decoders for all systems Best Prices Guaranteed. Helpful, friendly service and support ready to help. 30 day money back guarantee and full 1 year warranty call now 1-800-387-0349 Dealers Welcome Call for free price quote.

CABLE DESCRAMBLERS and converters, shop no more, best prices and tech support. Extreme Electronics 1-888-609-49410

CABLE TV DESCRAMBLERS, ALL MAJOR BRANDS, HAVE MAKE AND MODEL NUMBER OF CONVERTER USED IN YOUR AREA WHEN CALLING. QUANTITY DISCOUNTS. K.D. VIDEO, 1-800-327-3407.

## SATELLITE EQUIPMENT

SKYVISION! Your Satellite Home Entertainment Source. Best values: DBS and C/Ku-band equipment, including 4DTV. Most complete selection: Parts-Tools-Upgrades-Accessories! Free Discount Buyer's Guide. Call 800-543-3025. International 218-739-5231. [www.skyvision.com](http://www.skyvision.com).

DSS Hacking: How to construct and program smart cards, w/pic16C84, software. Complete DSS system schematics. \$16.95 CABLETRONICS Box 30502R Bethesda, MD 20824.

FREE DSS TEST CARD information package. Works on new system and turns on all channels including PPV, adult and sport channels. Write SIGNAL SOLUTIONS, 2711 Buford Rd., Suite 180, Richmond VA 23235.

VIDEOPHYSER II descrambling manual. Schematics, video and audio. Explains DES, EEPROM, CloneMaster, Pay-per-view \$16.95, \$2.00 postage. Schematics for Videocipher II Plus \$20.00. Schematics for Videocipher II 032, \$15.00. Software to copy and alter EEPROM codes, \$25.00. VCII Plus EEPROM, binary and source code, \$30.00. CABLETRONICS, Box 30502R, Bethesda, MD 20824

## TEST EQUIPMENT

TEST Equipment pre-owned now at affordable prices. Signal generators from \$50.00, oscilloscopes from \$50.00. Other equipment including manuals available. Send \$2.00 US for catalog. Refunded on first order. J.B. Electronics, 3446 Dempster, Skokie, IL 60076. (847) 982-1973.

TEST EQUIPMENT SALE! VIEW COMPLETE LIST AT WEB SITE "a-mail.com" or call NOW to receive list by fax or mail. AST GLOBAL ELECTRONICS: Voice 888-216-7159; Fax: 814-398-1176; e-mail:astmrktg@wrench.toolcity.net

## BUSINESS OPPORTUNITIES

I'M MAKING A "BUNDLE" reclaiming scrap gold from junk computers. Free info: 24 hrs, (603) 645-4767.

GREAT extra income ideal Assemble products at home for best companies. Information call: 1 (800) 377-6000 ext. 6870.

EASY WORK! EXCELLENT PAY! Assemble Products At Home. Call Toll Free 1-800-467-5566 EXT. 5192

PERSONAL COMPUTER OWNERS CAN EARN \$1000 To \$5000 MONTHLY offering simple services part time. Free list of 100 best services. Write: B.D.R.C.M., 5667 Harrison #124, Odgen, UT 84403-4322

## EDUCATION & INSTRUCTION

LEARN Electronics. Home study. Outstanding careers. Free literature. P.C.D.I., Atlanta, Georgia. 1 (800) 362-7070 Dept. ELC342.

PIC controller course, get up and running fast with Beginners PIC <http://www.telusplanet.net/public/rhenders>. Data Burst Software. Box 1193, Medicine Hat, AB. T1A7H3. 1-403-526-7676.

## AUDIO-VIDEO-LASERS

LASER Astonishing low prices. Free Catalog. T.E.P. PO Box 1353 Glendale, AZ 85311 Phone# 602-487-9897

## CB-SCANNERS

CB Radio Modifications! Books, plans, frequencies, sliders, 10-Meter, amplifiers, repairs, high-performance accessories. Catalog \$3. CBCI, Box 31500EN, Phoenix AZ 85046. (888)643-1800.

## WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR UNWANTED EQUIPMENT INTO CASH. AST GLOBAL ELECTRONICS: Voice 888-216-7159; Fax: 814-398-1176; e-mail: ast-mktg@wrench.toolcity.net

## SCRAMBLING NEWS

Best satellite TV news includes coverage of piracy. Voice/Fax 716-283-6910. [www.scramblingnews.com](http://www.scramblingnews.com)

## VIDEO INVERTER

### Create & Restore Inverted Video

R.C. Distributing

P.O. Box 552 • South Bend, IN 46624  
Website: [www.south-bend.net/rcc](http://www.south-bend.net/rcc)

For Free Information Package  
on Completed Units and Pricing  
Call 219-236-5776

## SURVEILLANCE

### The Latest High Tech Professional Electronic Devices

Our latest catalog offers a **HUGE** selection of surveillance, counter-surveillance/privacy devices:

hidden video equipment, pinhole cameras \$149<sup>00</sup>, telephone recording systems: 12-Hour \$139<sup>00</sup>

16-Hour \$199<sup>00</sup> touch tone decoders, scanners, bug/phone tap detectors, voice disguisers, telephone scramblers, locksmithing tools, and more.

Catalog \$5.00

## SPY OUTLET

P.O. Box 337, Buffalo, NY 14226  
(716) 695-8660/(716) 691-3476

WHOLESALE PRICES  
STARTING AS LOW AS \$99.00

## CABLE TV DESCRAMBLERS CONVERTERS FILTERS • VIDEO STABILIZERS

1 Year Warranty on All Products.  
Affordable Extended Warranty.  
**FREE CATALOG!**

30 Day  
FREE  
TRIAL

Call the Cable Professionals 24 Hours A Day!

Orion  
Electronics

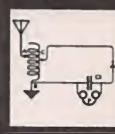
1-800-379-3976

[HTTP://WWW.ORION-ELECTRONICS.COM](http://WWW.ORION-ELECTRONICS.COM)



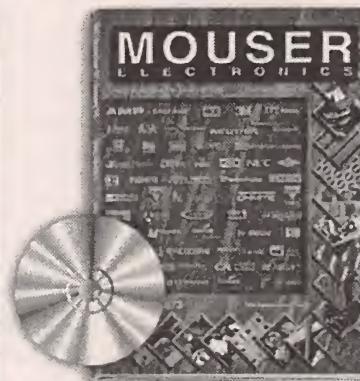
## Get your copy of the CRYSTAL SET HANDBOOK

THE CRYSTAL SET  
HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Claggs Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

## ELECTRONIC COMPONENTS



Visit our web site!

[www.mouser.com](http://www.mouser.com)

FREE catalog is available on the  
internet, CD-ROM, or in paper!

- 70,000+ Products
- 145 Manufacturers
- Same Day Shipping
- No Minimum Order

800-992-9943

817-483-6828 Fax: 817-483-0931  
[www.mouser.com](http://www.mouser.com) [catalog@mouser.com](mailto:catalog@mouser.com)

958 North Main St., Mansfield, TX 76063

**CMM**  
Monitor Test Equipment

## Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64Khz., eight step gray scale, white screen, single color mode. Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

**PRICE: \$295**

## Checker Jr.



Looking for a SMALL battery operated monitor test pattern generator that will fit in your pocket? The Checker Jr. is it. It displays a very useful 64 color pattern. You can evaluate size, focus, linearity, color tracking, and balance. It operates in the 640 x 480 mode (31.5Khz - 60Hz.) and is very easy to use. Use it anywhere.

**PRICE: \$99.95**

## Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it. All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling. With colorbars, gray scale, crosshatch with dots you can set and test quickly.

**Checker TV Pro...PRICE: \$599.95**

The TV Jr. is a small NTSC video generator with colorbars crosshatch with dots, white, red, blue, green, and black screens. Small enough to fit in your pocket, powerful enough to drive the largest projection TV!

**Checker TV Jr....PRICE: \$149.95**

**Computer & Monitor Maintenance, Inc.**  
1-800-466-4411 • 70-662-5633  
<http://www.computermonitor.com>

## ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology .....	94	— James Electronics .....	109
— ABC Electronics .....	106	— Lindsay Publications .....	109
— Active Micro .....	113	— Link Instruments .....	80
335 Advanced Graphic Systems .....	95	— Lynxmotion .....	112
— AES .....	80	— M2L Electronics .....	108
213 Alfa Electronics .....	105	331 Mark V Electronics .....	111
214 All Electronics .....	76	330 MCM Electronics .....	91
— Allison Technology .....	90	251 Mendelson Electronics Surplus .....	104
— Amaze Electronics .....	95	— Meredith Instruments .....	83
315 American Eagle Publications .....	90	323 Merrimack Valley Systems .....	80
— Andromeda Research .....	84	133 MicroCode Engineering .....	CV2
282 Basic Electrical Supply .....	96	— microEngineering Labs .....	114
— Brand Electronics .....	96	— Midwest Laser Products .....	113
326 Butterworth-Heinemann .....	78	— Modern Electronics .....	104
322 C&S Sales, Inc. ....	72	— Mondo-tronics Inc. ....	104
320 Capital Electronics .....	98	332 Mouser Electronics .....	115
327 Circuit Specialists .....	77	316 NCD Electronics .....	106
— Cleveland Inst. of Electronics .....	31	— NRI Schools .....	11, 39
— Command Productions .....	92	— Orion .....	115
— Computer Monitor Maint. ....	115	262 Parts Express Inc. ....	89
226 Consumertronics .....	94	— PC Boards .....	96
228 Cool Amp Conduco Lube .....	92	— Pioneer Hill Software .....	82
311 CTG .....	98	— Plug Power .....	114
313 Dalbani Electronics .....	87	— Polaris Industries .....	71
235 Danbar Sales .....	103	325 Prairie Digital .....	95
312 Dynamic Technology .....	112	— Price Wheeler .....	81
— EDE - Spy Outlet .....	115	264 Print (Pace) .....	85
— Electronic Tech.Today .....	CV3, 61	— QB Video .....	114
— Emac Inc. ....	97	266 Ramsey Electronics .....	93
— Fair Radio .....	113	— RC Distributing Co. ....	115
336 Foley-Belsaw .....	79	333 Roger's Systems Specialist .....	101
317 Fotronic .....	82	— Sil Walker .....	81
328 Gateway Products .....	88	— Square 1 Electronics .....	97
— General Device Instruments .....	84	334 Sun Equipment .....	74
122 Global Specialties .....	7	— Tab Books .....	19, 69
— Grantham Col. of Engineering .....	4	— TC Instruments .....	109
329 Graymark International .....	100	— Tekview .....	108
— Great Southern Security .....	107	324 Telulex .....	97
— Home Automation .....	84	— Test Equipment Sales .....	71
321 Howard Electronics .....	99	275 Timeline .....	86
— Howard Electronics .....	104	— U.S. Cyberlab .....	84
— IEC .....	94	318 Visitec Inc. ....	100
— Information Unlimited .....	75	— Weeder Technologies .....	113
126 Interactive Image Technologies CV4		314 White Star Electronics .....	88
— Intronics, Inc. ....	82	— Wisch Communications .....	90
319 IVEX Design .....	83	132 Windjammer Barefoot Cruises .....	4
134 IWATSU America .....	15	— World College .....	55
— J&M Microtek, Inc. ....	108	— WPT Publications .....	88

## ADVERTISING SALES OFFICES

**Gernsback Publications, Inc.**  
500 Bi-County Blvd.

Farmingdale, NY 11735-3931  
1-(516) 293-3000  
Fax 1-(516) 293-3115

**Larry Steckler**  
publisher (ext. 201)  
e-mail advertising@gernsback.com

**Adria Coren**  
vice-president (ext. 208)

**Ken Coren**  
vice-president (ext. 267)

**Christina Estrada**  
assistant to the publisher (ext. 209)

**Arline Fishman**  
advertising director (ext. 206)

**Marie Falcon**  
advertising assistant (ext. 211)

**Adria Coren**  
credit manager (ext. 208)

### For Advertising ONLY

#### EAST/SOUTHEAST

**Stanley Levitan**  
Eastern Advertising  
1 Overlook Ave.  
Great Neck, NY 11021-3750  
1-516-487-9357  
Fax 1-516-487-8402  
slevitan26@aol.com

#### MIDWEST/Texas/Arkansas/Oklahoma

**Ralph Bergen**  
Midwest Advertising  
One Northfield Plaza, Suite 300  
Northfield, IL 60093-1214  
1-847-559-0555  
Fax 1-847-559-0562  
bergenr@aol.com

#### PACIFIC COAST

**Janice Woods**  
Pacific Advertising  
Hutch Looney & Associates, Inc.  
6310 San Vicente Blvd., Suite 360  
Los Angeles, CA 90048-5426  
1-213-931-3444 (ext. 228)  
Fax 1-213-931-7309  
woodyowl@aol.com

#### Electronic Shopper

**Joe Shere**  
National Representative  
P.O. Box 169  
Idyllwild, CA 92549-0169  
1-909-659-9743  
Fax 1-909-659-2469  
Jshere@gernsback.com

#### Megan Mitchell

National Representative  
9072 Lawton Pine Avenue  
Las Vegas, NV 89129  
Phone/Fax 702-240-0184  
Lorri88@aol.com

#### Customer Service

1-800-999-7139  
7:00 AM - 6:00 PM M-F MST

# Reader Service Card

## MAIL-FAX OR E-MAIL YOUR REQUEST

Now you have 3 ways to request free information on products and services featured in this issue

To insure a prompt reply, please furnish all requested information

### To Receive Information on Products and Services in This Issue

Circle the numbers corresponding to the advertised products or editorial items that interest you.

Mail Card  
or Fax To: (413) 637-4343  
or E-Mail your request to:  
BERKCOMP@AOL.COM.

### For E-Mail users, your subject is

Electronics Now 3/98  
Format your message:

- Name and Address information
- Telephone and Fax numbers
- Requested item numbers separated by commas
- Responses to survey questions separated by dashes or slashes

NOTE: Submit all Free Information requests by **EITHER** Fax, mail, or E-Mail

**DUPLICATE REQUESTS WILL BE DISCARDED.** Use

for Free Information only.  
Address all editorial inquiries to Editor,  
Electronics Now,  
500 Bi-County Blvd.,  
Farmingdale, NY  
11735-3931

### BUSINESS PROFESSIONAL FREE INFORMATION CARD



4DAC1

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Dept. MS \_\_\_\_\_

Daytime Business Phone \_\_\_\_\_

Company Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip +4 \_\_\_\_\_

Unclear or incomplete mailing info will prevent our processing this request.

2  Please send me 12 issues (1 year) of ELECTRONICS NOW for \$19.97 and bill me. (Canada \$27.79 — US Funds only — Includes G.S.T.)

4  Please send me 12 issues (1 year) of POPULAR ELECTRONICS for \$18.95 and bill me. (Canada \$25.63 — US Funds only — Includes G.S.T.)

Do you use e-mail? 5  Yes 6  No

Which service do you use? 7  AOL 8  MSN 9  Juno  
10  At work 11  Local Service 12  Other

VOID after May 31, 1998      Allow 6-8 weeks for delivery of first issue

31 60 89 118 147 176 205 234 263 292 321 350  
32 61 90 119 148 177 206 235 264 293 322 351  
33 62 91 120 149 178 207 236 265 294 323 352  
34 63 92 121 150 179 208 237 266 295 324 353  
35 64 93 122 151 180 209 238 267 296 325 354  
36 65 94 123 152 181 210 239 268 297 326 355  
37 66 95 124 153 182 211 240 269 298 327 356  
38 67 96 125 154 183 212 241 270 299 328 357  
39 68 97 126 155 184 213 242 271 300 329 358  
40 69 98 127 156 185 214 243 272 301 330 359  
41 70 99 128 157 186 215 244 273 302 331 360  
42 71 100 129 158 187 216 245 274 303 332 361  
14 43 72 101 130 159 188 217 246 275 304 333 362  
15 44 73 102 131 160 189 218 247 276 305 334 363  
16 45 74 103 132 161 190 219 248 277 306 335 364  
17 46 75 104 133 162 191 220 249 278 307 336 365  
18 47 76 105 134 163 192 221 250 279 308 337 366  
19 48 77 106 135 164 193 222 251 280 309 338 367  
20 49 78 107 136 165 194 223 252 281 310 339 368  
21 50 79 108 137 166 195 224 253 282 311 340 369  
22 51 80 109 138 167 196 225 254 283 312 341 370  
23 52 81 110 139 168 197 226 255 284 313 342 371  
24 53 82 111 140 169 198 227 256 285 314 343 372  
25 54 83 112 141 170 199 228 257 286 315 344 373  
26 55 84 113 142 171 200 229 258 287 316 345 374  
27 56 85 114 143 172 201 230 259 288 317 346 375  
28 57 86 115 144 173 202 231 260 289 318 347 376  
29 58 87 116 145 174 203 232 261 290 319 348 377  
30 59 88 117 146 175 204 233 262 291 320 349 378

### BUSINESS PROFESSIONAL FREE INFORMATION CARD



4DAC1

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Dept. MS \_\_\_\_\_

Daytime Business Phone \_\_\_\_\_

Company Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip +4 \_\_\_\_\_

Unclear or incomplete mailing info will prevent our processing this request.

2  Please send me 12 issues (1 year) of ELECTRONICS NOW for \$19.97 and bill me. (Canada \$27.79 — US Funds only — Includes G.S.T.)

4  Please send me 12 issues (1 year) of POPULAR ELECTRONICS for \$18.95 and bill me. (Canada \$25.63 — US Funds only — Includes G.S.T.)

Do you use e-mail? 5  Yes 6  No

Which service do you use? 7  AOL 8  MSN 9  Juno  
10  At work 11  Local Service 12  Other

VOID after May 31, 1998      Allow 6-8 weeks for delivery of first issue

31 60 89 118 147 176 205 234 263 292 321 350  
32 61 90 119 148 177 206 235 264 293 322 351  
33 62 91 120 149 178 207 236 265 294 323 352  
34 63 92 121 150 179 208 237 266 295 324 353  
35 64 93 122 151 180 209 238 267 296 325 354  
36 65 94 123 152 181 210 239 268 297 326 355  
37 66 95 124 153 182 211 240 269 298 327 356  
38 67 96 125 154 183 212 241 270 299 328 357  
39 68 97 126 155 184 213 242 271 300 329 358  
40 69 98 127 156 185 214 243 272 301 330 359  
41 70 99 128 157 186 215 244 273 302 331 360  
42 71 100 129 158 187 216 245 274 303 332 361  
14 43 72 101 130 159 188 217 246 275 304 333 362  
15 44 73 102 131 160 189 218 247 276 305 334 363  
16 45 74 103 132 161 190 219 248 277 306 335 364  
17 46 75 104 133 162 191 220 249 278 307 336 365  
18 47 76 105 134 163 192 221 250 279 308 337 366  
19 48 77 106 135 164 193 222 251 280 309 338 367  
20 49 78 107 136 165 194 223 252 281 310 339 368  
21 50 79 108 137 166 195 224 253 282 311 340 369  
22 51 80 109 138 167 196 225 254 283 312 341 370  
23 52 81 110 139 168 197 226 255 284 313 342 371  
24 53 82 111 140 169 198 227 256 285 314 343 372  
25 54 83 112 141 170 199 228 257 286 315 344 373  
26 55 84 113 142 171 200 229 258 287 316 345 374  
27 56 85 114 143 172 201 230 259 288 317 346 375  
28 57 86 115 144 173 202 231 260 289 318 347 376  
29 58 87 116 145 174 203 232 261 290 319 348 377  
30 59 88 117 146 175 204 233 262 291 320 349 378

**To Order a New Subscription or  
To Renew an Existing Subscription  
Call 1-800-999-7139**

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

**Electronics**  
**NOW** (R)

**READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989**

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

**Electronics**  
**NOW** (R)

**READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989**

# Budget Project and Computer Books

**BP317—Practical Electronic Timing \$8.99.** Time measurement projects are among the most constructed gadgets by hobbyists. This book provides the theory and backs it with a wide range of practical construction projects. Each project has how-it-works theory and how to check it for correct operation.

**BP415—Using Netscape on the Internet** BRAND NEW

**\$12.75.** Get with the Internet and with surfing, or browsing, the World Wide Web, and with the Netscape Navigator in particular. The book explains: The Internet and how the World Wide Web fits into the general scenario; how do you go about getting an Internet connection of your own; how to download and install the various versions of Netscape browsing software that are available; and how to use Netscape Navigator to surf the Web, and to find and maintain lists of useful sites. There's a heck of a lot more, too!

**BP325—A Concise User's Guide to Windows 3.1 \$8.99.**

Now you can manage Microsoft's Windows with confidence. Understand what hardware specification you need to run Windows 3.1 successfully, and how to install, customize, fine-tune and optimize your system. Then you'll get into understanding the Program Manager, File Manager and Print Manager. Next follows tips on the word processor, plus how to use Paintbrush. There's more on the Cardfile database with its auto-dial feature, Windows Calendar, Terminal, Notepad, etc.

**BP327—DOS: One Step at a Time \$8.99.**

Although you spend most of your time working with a word processor, spreadsheet or database, and are probably quite happy using its file management facilities, there will be times when you absolutely need to use DOS to carry out 'house-keeping' functions. The book starts with an overview of DOS, and later chapters cover the commands for handling disks, directories and files.

**PCP119—Electronic Music and Midi Projects \$14.95.**

Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.

**PCP120—Multimedia on the PCI \$14.95.**

What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more fun, fun, fun into your leisure computer activities.

**BP404—How To Create Pages for the Web Using HTML \$10.99.** Companies around the world, as well as PC users, are fast becoming aware of the World Wide Web as a means of publishing information over the Internet. HTML is the language used to create documents for Web browsers such as Mosaic, Net-scape and the Internet Explorer. These programs recognize this language as the method used to format the text, insert images, create hypertext and fill-in forms. HTML is easy to learn and use. This book explains the main features of the language and suggests some principles of style and design. Within a few hours, you can create a personal Home Page, research paper, company profile, questionnaire, etc., for world-wide publication on the Web.



BRAND NEW

**BP377—Practical Electronic Control Projects \$10.99.** Electronic control theory is presented in simple, non-mathematical terms and is illustrated by many practical projects suitable for the student or hobbyist to build. Discover how to use sensors as an input to the control system, and how to provide output to lamps, heaters, solenoids, relays and motors. Also the text reveals how to use control circuits to link input to output including signal processing, control loops, and feedback. Computer-based control is explained by practical examples.

**BP411—A Practical Introduction to Surface Mount Devices \$8.99.** This book takes you from the simplest possible starting point to a high level of competence in working with Surface Mount Devices (SMD's). Surface mount hobby-type construction is ideal for constructing small projects. Subjects such as PCB design, chip control, soldering techniques and specialist tools for SMD are fully explained. Some useful constructional projects are included.

**BP136—25 Simple Indoor and Window Aerials \$3.50.** Many people live in flats and apartments where outdoor antennas are prohibited. This does not mean you have to forgo shortwave listening, for even a 20-foot length of wire stretched out under a rug in a room can produce acceptable results. However, with experimentation and some tips, you may well be able to improve further your radio's reception. Included are 25 indoor and window antennas that are proven performers. Much information is also given on shortwave bands, antenna directivity, time zones, dimensions, etc. A must book for all amateur radio enthusiasts.

**BP336—A Concise User's Guide to Lotus 1-2-3 Release 3.4 \$7.25.** Discover how to use a three-dimensional Lotus spreadsheet in the shortest and most effective way. The book explains how: to generate and manipulate 3-dimensional worksheets and how to link different files together; to generate and add graphs to a worksheet, edit them, and then preview and print the worksheet; to use the SmartIcons and become more productive with your time; to use the WYSIWYG add-in to produce top quality screen and printed displays; and much more.

**BP379—30 Simple IC Terminal Block Projects \$8.99.** Here are 30 easy-to-build IC projects almost anyone can build. Requiring an IC and a few additional components, the book's 'black-box' building technique enables and encourages the constructor to progress to more advanced projects. Some of which are: timer projects, op-amp projects, counter projects, NAND-gate projects, and more.

**BP401—Transistor Data Tables \$10.99.** The tables in this book contain information about the package shape, pin connections and basic electrical data for each of the many thousands of transistors listed. The data includes maximum reverse voltage, forward current and power dissipation, current gain and forward transadmittance and resistance, cut-off frequency and details of applications.

**BP403—The Internet and World Wide Web Explained \$10.99.** You've heard about the Information Superhighway. Sort of makes you feel timid about getting on the Web. Put your fears aside! This book eliminates the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will call you an Internet guru!

**BP92—Electronics Simplified: Crystal Set Construction \$2.69.** This book is written for those who wish to participate in electronics more through practical construction than by theoretical study. It is designed for all ages upwards from the day when one can read intelligently and handle simple tools. The crystal set projects are designed to use modern inexpensive components and home-wound coils. A book highly recommended for all newcomers.

**ETT1—Wireless & Electrical Encyclopedia \$5.75.** Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.

**ELECTRONIC TECHNOLOGY TODAY INC.**  
P.O. BOX 240, Massapequa, NY 11762-0240

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

NW2

Allow 6-8 weeks for delivery

**SHIPPING CHARGES IN USA AND CANADA**

\$0.01 to \$5.00.....	\$2.00
\$5.01 to \$10.00.....	\$3.00
\$10.01 to \$20.00.....	\$4.00
\$20.01 to \$30.00.....	\$5.00
\$30.01 to \$40.00.....	\$6.00
\$40.01 to \$50.00.....	\$7.00

\$50.01 and above.....\$8.50

**SORRY No orders accepted outside of USA & Canada**

**No. of Books Ordered**

Total price of books ..... \$ \_\_\_\_\_  
Shipping (see chart) ..... \$ \_\_\_\_\_  
Subtotal ..... \$ \_\_\_\_\_  
Sales Tax (NYS only) ..... \$ \_\_\_\_\_

**Amount Enclosed** .....

All payments must be in U.S. funds!

# Better Designs - Faster

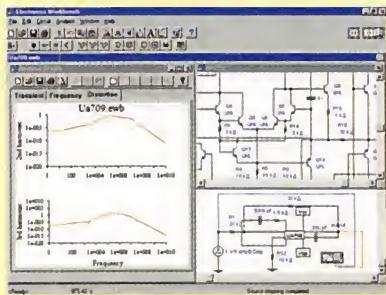
## With the Personal Design Solution

The Design Solution Includes: Electronics Workbench Personal Edition + EWB Layout

### Electronics Workbench<sup>®</sup> *Personal Edition*

#### Full-featured schematic capture and SPICE 3F circuit simulation!

The world's best selling circuit design software. With analog, digital and mixed A/D SPICE simulation, a full suite of analyses and over 4000 devices. Imports netlists. Seamlessly integrated with EWB Layout or exports to other popular PCB programs. Still the standard for power and ease of use. Still the same effective price.



**\$299**  
Version 5

#### HIGH-END FEATURES

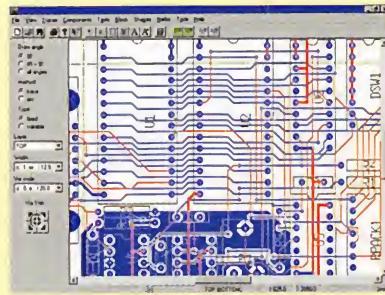
TRUE MIXED ANALOG/DIGITAL	YES
FULLY INTERACTIVE SIMULATION	YES
PRO SCHEMATIC EDITOR	YES
HIERARCHICAL CIRCUITS	YES
VIRTUAL INSTRUMENTS	YES
ON-SCREEN GRAPHS	YES
ANALOG AND DIGITAL MODELS	OVER 4,000
FREE TECHNICAL SUPPORT	YES
DC OPERATING POINT	YES
AC FREQUENCY	YES
TRANSIENT	YES
FOURIER	YES
NOISE	YES
DISTORTION	YES

**30-DAY MONEY-BACK  
GUARANTEE**

### Electronics Workbench<sup>®</sup> *Layout* *Personal Edition*

#### Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, you can incorporate board layout and design and quickly bring well-designed boards to production.



**\$299**  
Version 5

#### POWER-PACKED FEATURES

AUTOROUTING	YES
REROUTE WHILE MOVE	YES
LAYERS	32 ROUTING LAYERS
BOARD SIZE	50" X 50"
LIBRARY SHAPES	OVER 3,500
BLIND AND BURIED VIAS	YES
EXTENSIVE OUTPUT	YES
SELECTIVE NET HIGHLIGHTING	YES
USER DEFINED PADS	YES
REAL TIME DESIGN RULE CHECK	YES
DENSITY HISTOGRAMS	YES
FREE TECHNICAL SUPPORT	YES

Join over 85,000 customers  
and find out why more circuit designers  
buy Electronics Workbench than  
any other circuit design tool.

**CALL FOR INFORMATION  
AND PRICING ON OUR  
PROFESSIONAL EDITION.**

**ELECTRONICS WORKBENCH Personal Edition \$299.00**  
**EWB LAYOUT Personal Edition \$299.00**

**BUY  
BOTH  
AND  
SAVE**

**PERSONAL DESIGN SOLUTION**

~~\$598.00~~  
**\$548.00**

**CALL 800-263-5552**

For a free demo, visit our website  
at <http://www.interactiv.com>

INTERACTIVE IMAGE TECHNOLOGIES LTD., 908 Niagara Falls Boulevard,  
#068, North Tonawanda, New York 1420-2060 / Telephone 416-977-5550.

TRADEMARKS ARE PROPERTY OF THEIR RESPECTIVE HOLDERS. OFFER IS IN U.S. DOLLARS AND VALID ONLY  
IN THE UNITED STATES AND CANADA. ALL ORDERS SUBJECT TO \$15 SHIPPING AND HANDLING CHARGE.

**Fax: 416-977-1818** E-mail:[ewb@interactiv.com](mailto:ewb@interactiv.com)  
CompuServe: 71333,3435 / BBS: 416-977-3540

